SCIENTIFIC AMERICAN

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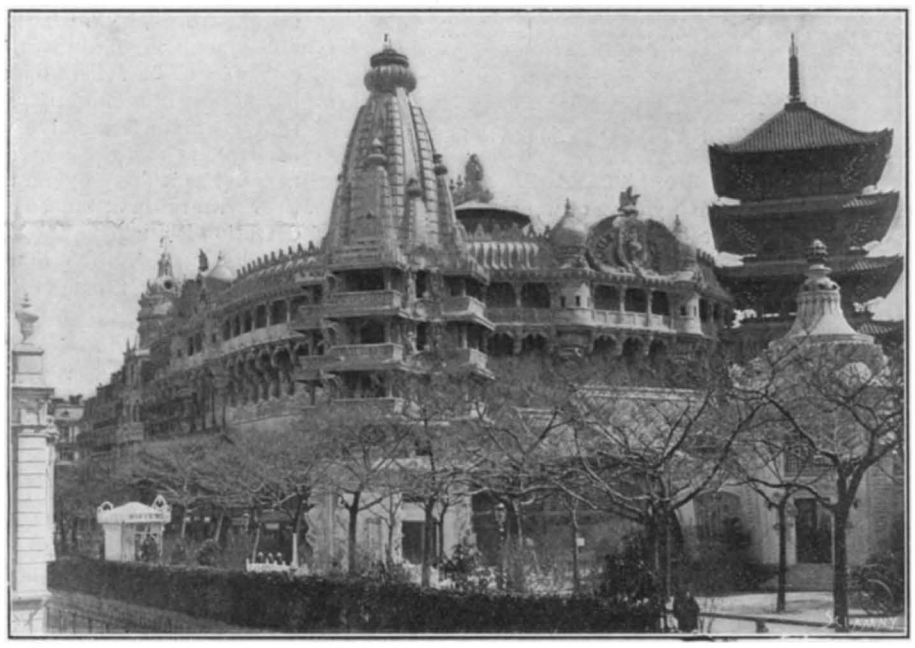
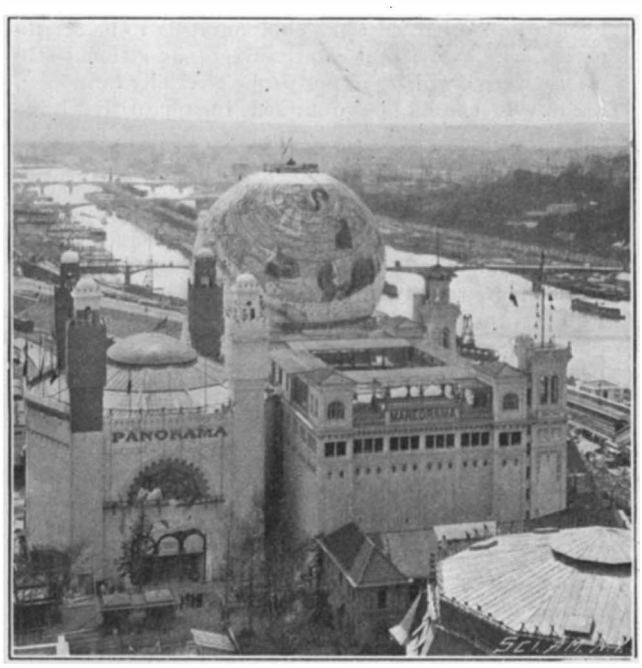
The Siberian Building.



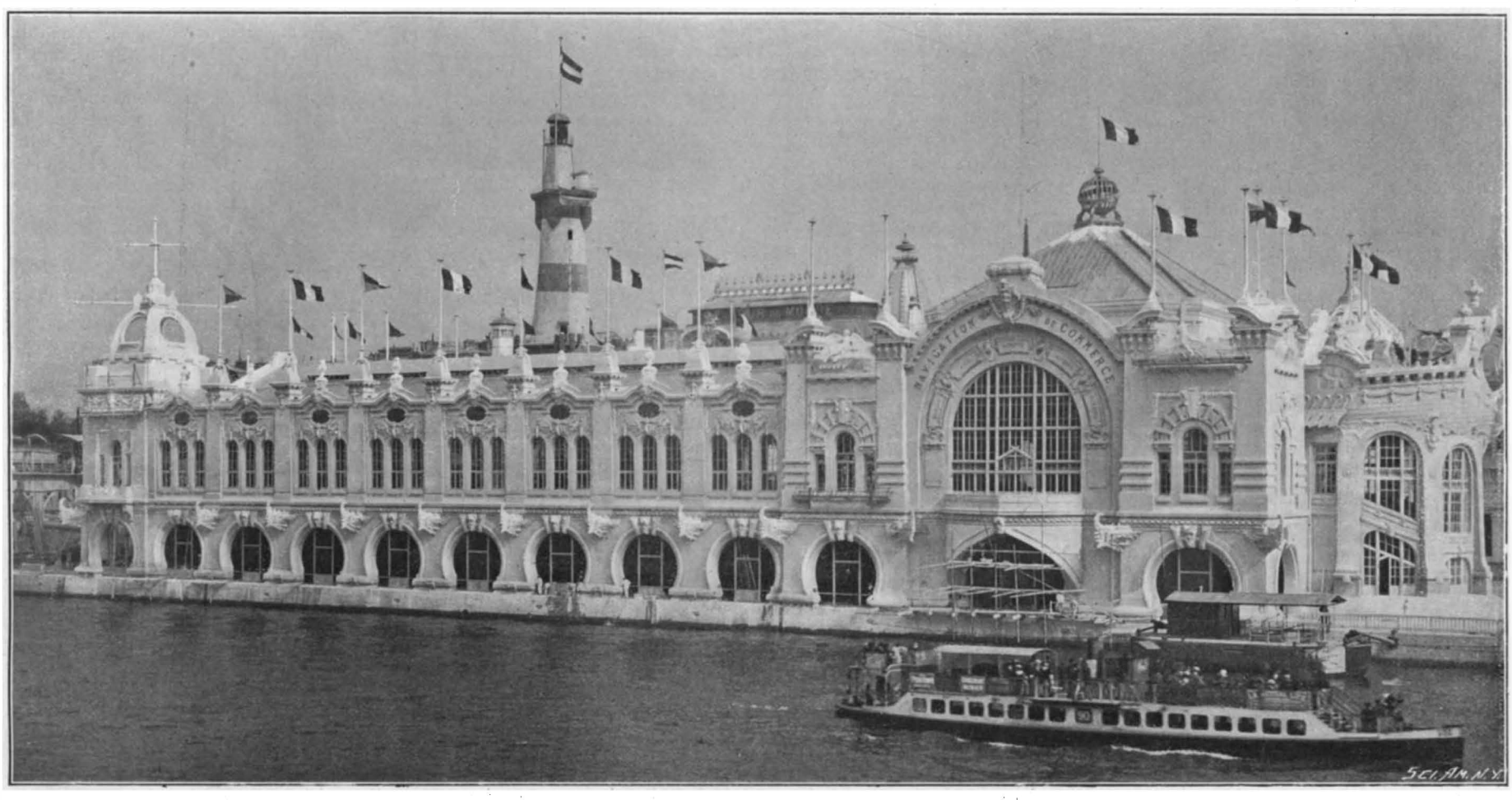
The Tour de Monde.

Indo-Chinese God with the Banyan Tree.



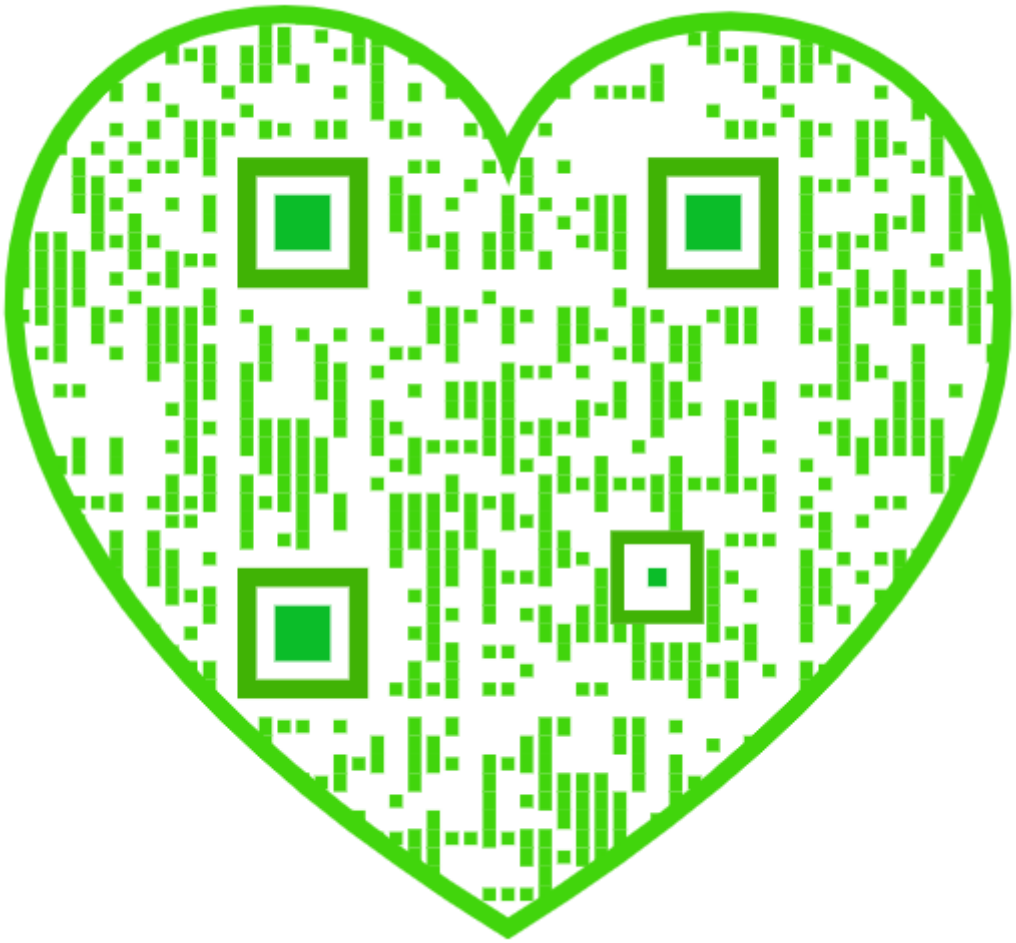
The Celestial Globe.

Buildings on the Esplanade des Invalides.



Commerce and Navigation Building on the Bank of the Seine.

SOME UNIQUE ATTRACTIONS OF THE PARIS EXPOSITION.—[See page 374.]



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THE ARMOR PLATE FIASCO.

Once again, after many days of wearisome and profitless debate, the curtain has been rung down in Congress upon that perennial farce known as the armor-plate controversy. Were the issues involved less vital to the highest interests of the nation, this annual discussion would be, to the impartial and unprejudiced onlooker, simply a diverting spectacle—so curiously compounded is it of politics and prejudice, persistent misstatement, and unpardonable ignorance of fundamental and easily ascertained facts.

Unfortunately, the question of the supply of armor for our battleships, with which Congress has trifled so long, is of the most vital importance to a nation which is rapidly enlarging the field of its imperial interests, and assuming responsibilities which call for a vast increase in its naval and military strength. Every American that appreciates the momentous changes in our international policy which both involved and grew out of our war with Spain, realizes that the possession of a powerful and growing navy is now more than ever an absolute necessity. To such people the spectacle of the whole work of building up the navy being held up by the vociferous oratory of a small handful of congressmen is painful and alarming to the last degree—particularly when it is borne in mind that these very gentlemen who refuse to provide the weapons of war will probably be the most eager for blood-letting in any international quarrel that may arise.

Now that the Senate has given way, and the construction of our warships is to proceed, it is well to point out just how much delay has been occasioned by a controversy that has been altogether barren of results. In the first place, until a week ago, when the deadlock was broken, the construction of no less than nine first-class battleships and three armored cruisers was prohibited, and if the obstructionists had gained their point, the embargo would have lasted for yet another year. The first vessels to be affected were the "Alabama," "Illinois," and "Wisconsin," which were authorized in 1896, and, but for interference, would have been completed during the summer of 1899. As it was, an impossible limit of $300 per ton was put upon the price of the armor, the ultimate result of which was that the war Congress of 1898 was confronted with the spectacle of these three ships, ready for launching, but absolutely devoid of armor. Permission was now instantly given for the closing of contracts for armor, no price whatever being stipulated. Armor-plate, however, takes much time to fabricate, and Congress was presented with the first fruits of its folly in the shape of three costly but unfinished ships that could not by any possibility be available, even if the war were protracted beyond all reasonable possibility.

And thereby hangs a tale, the moral of which is so obvious as to warrant a recital, in the vain hope that some recalcitrant obstructionist may profit thereby. When the certainty of a war was upon us, instructions were given to a shipbuilding firm that had one of the unfinished battleships in hand to draw up plans for placing *wooden armor* upon the sides, barbettes and turrets, with a view to filling in the yawning gaps, for which, thanks to Congress, there was no plating available. The guns were to be placed aboard, and our gunners, snugly ensconced behind this painted sham, were to be sent out under the protection, at least, let us hope, of a merciful Providence. If it were not so painful, this incident would be positively funny; and the least we can hope is that the contemplation of that humiliating episode will effectually prevent its recurrence in a future emergency.

The total delay on the three ships under discussion has been eighteen months; on the three vessels of the "Maine" class, twelve months; while the closing of the contracts for the six vessels of the "Georgia" and "California" classes has been delayed for at least a year.

TWO REMARKABLE ACHIEVEMENTS IN CHEMICAL PHYSICS.

Before the London Royal Society two papers were recently read, the one by Sir William Crookes, the other by Sir W. Roberts-Austen, which, apart from the fact that they dealt with achievements of the utmost importance to scientists, illustrate how painstaking is the work of the modern scientific investigator and how delicate are the methods which he employs.

Sir William Crookes described his experiments in the analysis of the compounds of uranium, an exceedingly rare metal, which, Becquerel found, emitted rays that affected a photographic plate, even though an opaque object intervened. This remarkable property is even more pronounced in other metals, notably in radium and polonium, for which reason it was suggested that uranium rays were due to the presence of minute quantities of these more active metals in uranium. It was the object of the experiments made by Sir William Crookes to ascertain whether uranium was in itself capable of emitting light-rays, or whether its strange property was to be attributed to some other body present in the form of an impurity. His investigations proved that uranium is inactive when pure, that polonium, at least, is not the energetic substance, and that the rays are sent forth by an unknown element, not identical with radium, but so closely resembling it, that its detection is a matter of extreme difficulty.

In his analysis, Sir William Crookes used pitchblende (uranium oxide); for he found that it was more highly radiant than any other uranium compound; and should, consequently, contain the body sought in the largest quantity. He endeavored first to ascertain whether the property was most noticeable in any particular salt of uranium. But his experiments showed that all salts were active; that as the salt increased in purity the phenomenon was not so marked, and that extremely pure uranium did not affect a photographic plate. The natural inference was that uranium had not the property, and that the rays were emitted by some impurity in pitchblende. Polonium, Crookes determined, could not be the metal which he was seeking. Radium is more nearly coincident with the energetic substance; but the fine differences which he detected led him to conclude that the radiant property of pitchblende and other uranium compounds is to be attributed to the very slight admixture of an element still undiscovered, which can not yet be critically examined, because it cannot be obtained in quantities large enough for experiment.

The nicety of the method of investigation employed by Crookes, and the importance of the conclusions which he drew from his investigations, can be fully appreciated only by chemists. The significance of the work of Sir W. Roberts-Austen, on the other hand, will be more readily understood. Four years ago, Sir Roberts-Austen stated that if a column of lead be placed upon a column of gold, and the two metals heated below the fusing-point of lead, the gold evaporates, so that even after a period so short as twenty-four hours, traces of gold can be detected in the lower portion of the leaden column. In order to prove that at common temperatures also, the nobler metal gives off vapors which penetrate the baser body, he subjected the superposed metals to the ordinary heat of 65° F. for a period of four years. At the end of that time he found that the gold had diffused itself in the lead, and that the amount of gold thus diffused diminished as the distance between the two columns increased. He has not proven that gold evaporates without the presence of another metal; but he has certainly demonstrated that two metals may mingle without the application of extraordinary heat.

OUR PHENOMENAL EXPORTS.

An exportation of $40,000,000 worth of manufactures in thirty days is a record unparalleled for American manufacturers. That is the record for the month of April, 1900. The details of the April exportations, just completed by the Treasury Bureau of Statistics, show that the exportation of manufactures during that month was by far the greatest of any month in our history, and within a fraction of $40,000,000. This gives assurance that the exports of the fiscal year, which ends with June, will considerably exceed $400,000,000, and be nearly three times as much as a decade ago. This phenomenal increase in exportation of manufactures is especially striking when compared with the progress made by European nations, our rivals in the attempt to supply the world's market with manufactured goods. Great Britain's exports of manufactures show but slight increase since 1890, and an examination of the export record of the principal European countries fails to disclose an instance in which the increase has been as much as 25 per cent, while that of the United States, meanwhile, has been more than 150 per cent.

An examination of the details of our own exportation of manufactures shows that it is in the production, manufacture and exportation of metals that we seem to excel. The history of nations and peoples shows that great groups of people frequently excel in certain industries, and the growth of our exportation, as well as our domestic production of manufactures, seems to point to metals as our most successful line of work, especially at the present time. In 1889, manufactures of metals formed less than 20 per cent of our total exportation of manufactures, and in 1900 will be about 45 per cent of our exports of manufactures. The increase in exportation of metals and manufactures thereof in the decade 1889–1898 was 339 per cent, while the increase in the exportation of all manufactures in that time was but 110 per cent, and the increase in manufactures other than those of metal during that time was but 55 per cent. In this statement of the exportation of manufactures of metals, only those articles composed exclusively of metals are included; those made up in part of metals, such as railway cars, agricultural machinery, etc., being included in the other manufactures. The rapid increase in the exportation of manufactures of metals is shown by the fact that the exports of brass and manufactures thereof in 1889 were but $321,137, and in 1900 will reach $1,700,000; instruments for scientific purposes increased from $1,033,338 to $2,270,803, and in the year about to end will reach nearly $6,000,000; copper and its manufactures, which amounted in 1889 to $2,348,954, will be more than $50,000,000 in 1900; iron and steel increased from $21,156,077 in 1889 to $70,406,885 in 1898, while in the fiscal year 1900 they will exceed $100,000,000.

Another interesting fact developed by the examination of the figures is that the European countries, in which manufactures have been long established, furnish as satisfactory a market for our manufactured goods as do the countries where manufacturing has not yet been largely developed. In reapers and mowers, clocks and watches, sewing machines, bicycles, and the various manufactures of iron and steel, and many other articles of the higher grades of manufacture, the European countries, in which manufacturing plants and machinery and skilled workmen abound, furnish a market for a large share of our exports, thus failing to justify the expressed fear that a development of manufactures in countries where we are now seeking a foothold for our commerce would destroy their value as a permanent market.

In this attempt to show the growth of the exportation of each article in every direction, it has only been practicable to measure the growth by values, as the varying value of the units of quantity designated by a common name would prove confusing and misleading. A statement of the number of watches, clocks, sewing machines, typewriters, electrical instruments, mowers and reapers, carriages, articles of glass and china ware, builders' hardware, and miscellaneous articles of cotton and woolen goods, for instance, in which the value of units ranges from a few dollars to hundreds in a single class, would convey no information for comparative purposes and does not supply any facility for measuring the real growth of the industry or the commerce in it, as does the simple statement of total values by classes. On the other hand, the well-known fact that prices of nearly all classes of manufactured goods have greatly increased by reason of cheapened and improved methods of production renders a mere statement of values somewhat misleading in an attempt to determine the actual increase in the exportation of numbers or quantity of nearly all articles.

As already indicated, the largest growth in our export of manufactures is in that of metals. The largest class of manufactures of metals exported is that of iron and steel. In 1880 the export of manufactures of iron and steel was $14,716,524, and in 1900 will exceed $100,000,000, or more than seven times that of 1880.

In no feature of our export trade has there been a more remarkable growth during the decade than in rails for railways, especially those of steel. The total exportation of iron rails in 1889 was but 7 tons, and in 1898, 2,769 tons, the value rising from $240 in 1889 to $37,150 in 1898. In steel rails, however, the growth was even more remarkable, the number of tons exported in 1889 being 7,398, and in 1898, 229,782, while the value increased from $235,387 in 1889 to $4,613,376 in 1898 and in the fiscal year 1900 is likely to reach $8,000,000. This increase has been especially marked during the past three years, the exports of steel rails in the fiscal year 1896 being $540,797; those of 1897, $2,482,208; those of 1898, $4,613,376; and those 1899, $5,298,125; while the first ten months of the present fiscal year show a gain of about $2,000,000 over the corresponding months of last year. While this rapid increase is due to a generally increased demand, the countries showing the most marked growth in their purchases of steel rails from the United States are Russia, Canada, and Japan.

THE RAILROAD SYSTEMS OF ASIA.

The total length of the railroads in Asia is 30,000 miles, of which two-thirds are represented by British India. The Trans-Siberian alone has 5,800 kilometers. In China the different European and American syndicates have obtained concessions for about 3,000 miles of railroad, and these are for the most part in construction. The Chinese government possesses also about 300 miles of lines whose operation is now being carried out under good conditions, especially for the lines uniting Pekin to the port of Tientsin. Japan has no less than 3,100 miles of railroad, and the French colonies, which now possess but 250 miles, have more than 2,500 miles in construction in Cochin-China, Annam and Tonkin. The Dutch East Indies have a well developed system, Java alone having 1,000 miles. These figures are far surpassed by those for British India, whose system has a total

length of 21,100 miles. Persia has as yet no railroad systems, but the Russian syndicates appear to be ready to profit by the monopoly which they have secured for the construction of railroads in that country. Turkey is adding a number of important lines of road to the 1,600 miles already possessed in Asia; the Franco-German line, of Bagdad, is one of the largest of these systems.

ELECTRICAL SUPPLY BY GAS COMPANIES.

BY ALTON D. ADAMS.

That the essential equipment in gas service is well suited to serve an important purpose in electrical supply has become apparent with the development of the gas-engine. A gas works ready to deliver a large supply of gas at any point in a wide and thickly settled area can operate in that area a number of gas-driven electric stations at a minimum cost. There are two very good reasons why such gas-driven stations can be operated with decided advantage by gas companies. One of these reasons lies in the fact that electric energy from these small stations can be sold for several times the price of the gas consumed in its operation. The other reason is due to conditions that make it possible to generate electric energy at such stations at a less sum per unit than with most other systems.

First consider the selling-price of gas consumed to drive dynamos and the market value of the electric output. For gas-engines of not less than 100 horse power, such as would be used at these small electric stations, a consumption of 18 cubic feet of gas, containing 700 heat units per cubic foot, is sufficient, per brake horse-power hour developed, at nearly full load. Direct-current dynamos, in sizes to compare with the engines just named, easily show a full load efficiency of 90 per cent. Each electrical horse-power output at the dynamo terminals requires, therefore, the consumption of $18 \div 0{\cdot}90 = 20$ cubic feet of gas in the engines. As the electrical horse-power hour, or 746 watt-hours, is very close to three-fourths of the kilowatt-hour, the latter requires $20 \div 0{\cdot}75 = 26{\cdot}7$ cubic feet of gas at the engine. In the largest cities, the average price per kilowatt-hour is about ten cents. Under similar conditions the average price of gas containing 700 heat-units per cubic foot is about one dollar per thousand cubic feet. At this rate, the 26·7 cubic feet of gas necessary to produce one kilowatt-hour at the dynamo terminals have a selling price of 2·67 cents. The product of the electric plant is, therefore, $10 \div 2{\cdot}67 = 3{\cdot}75$ times as valuable as the gas consumed in its engines. The 26·7 cubic of gas should supply five or six sixteen-candle power burners during one hour. The most common efficiency for incandescent electric lamps is 3·5 watts per candle, or 56 watts per lamp, so that one lamp-hour corresponds to 56 watt-hours. The gas-engine and dynamo deliver 1,000 watt-hours on a consumption of 26·7 cubic feet of gas per hour, so that this amount of gas, through the medium of the electric plant, supplies energy for $1000 \div 56 = 18$ incandescent lamp-hours nearly. In other words, gas, used in an engine to drive a dynamo, will operate three times as many incandescent electric lamps as gas-burners of equal candle-power. If the electric energy from the gas-driven dynamo be used in arc lamps, the illuminating effect produced from a given quantity of gas is still further increased. The actual average candle-powers of arc-lamps is about one-fourth of the nominal candle-powers. On a basis of their actual average illuminating powers, arc-lamps consume 1 watt of electrical work per candle-power. One kilowatt-hour of electrical energy thus produces 1,000 candle-power hours at the arc-lamp, while the 26·7 cubic feet of gas consumed to generate 1 kilowatt-hour give about $16 \times 6 = 96$ candle-power hours at the gas-burners. Gas used to drive an engine and dynamo supplies about ten times as much illumination at arc-lamps as it could give off if burned directly for lighting purposes.

It may now be considered whether the first cost and operating expenses of small electric plants, as part of a gas system, would be such as to offset the higher return on a given amount of gas. Many a gas system would, probably, supply a number of small electric generating stations along its main pipe lines, with increase of the latter or additions to the plant for gas production. This opinion is based on the fact that gas-producing equipment is not usually worked to its full capacity during all hours of the day, and that gas-mains have a very small flow during the greater part of each twenty-four hours. Moreover, an increase from the pressures of a few ounces per square inch, now common, to pressures of several pounds will materially multiply the possible delivery from present mains. Neglecting then, for the moment, any possible outlay for the increase of gas plants and mains, the first cost of electric stations supplied by these mains may be considered. There are some very obvious advantages of gas-driven over steam-driven electric stations. With gas-engines no boilers and no high chimneys are necessary; the handling of coal and ashes is avoided; only sufficient water is necessary to make good the evaporation due to cooling; and a generating equipment of relatively large capacity requires but a small space. These features of gas-driven electric plants reduce to a minimum the charges that must be made against them for real estate. The installed cost of gas-engines and dynamos, with all connections and accessories, should not exceed one hundred dollars per kilowatt of electric output capacity. During ten hours operation at full load, the value of the output from this gas and electric machinery would amount to one per cent of its cost, and four months of such operation, averaging ten hours per day, would give a gross return equal to the entire investment. It would probably prove desirable to install storage batteries with capacities of, perhaps, twenty per cent of the maximum rates of output at these gas-driven electric stations, to steady the station voltage, keep working engines fully loaded and supply the entire demand at times of minimum loads. These batteries, however, would reduce the necessary engine and dynamo equipment by an amount equal to the battery capacity, because all would work together during the short periods of maximum loads. The weight of the electrical conductors for a given electric pressure, rate of energy transmission, and per cent of loss must vary as the squares of the distances between stations and consumers. One distinctive feature of the plan here proposed is that these distances are short—much shorter than those over which present electric systems usually extend—and the cost of conductors will, therefore, be comparatively light. As an approximate figure, it may be said that the total outlay for the distribution system between these gas-driven stations and their customers should be about fifty dollars per kilowatt capacity of conductors at their maximum loads, on an average, or about one-half the expense for plant equipment. In order thus to increase the gross return on gas about 3·75 times, there must be added to fixed investment about $150 for each 26·7 cubic feet of gas consumed, for the increased return, per hour. The electric energy produced from these 26·7 cubic feet of gas hourly has a market value of $10 - 2{\cdot}67 = 7{\cdot}33$ cents more than that of the gas, and, allowing 3,000 working-hours at full capacity per year, the increase of revenue from the gas used in the electric generating and distributing equipment, at the estimated cost of $150, amounts to $\$0{\cdot}0733 \times 3{,}000 = \$219.90$. Labor in an electric plant driven by gas-engines is a comparatively small item, and much below the necessary amount of work to operate a steam and electric station of equivalent capacity. Whether these main facts, and the many minor ones bearing on the subject, warrant the supply of electric energy from numerous, comparatively small gas-driven plants must depend, in some measure, on the relative first cost and operating expenses of steam and electric plants for the same service.

The economical transmission of electric energy is a very real and pressing problem in the design and operation of extensive electric systems. The necessary sub-stations for a high-pressure electric system require fully as much room and more equipment than would gas-driven electric generating stations of equal capacity. In batteries, the most expensive element of equipment, the electric sub-station requires more than the gas-driven plant of the same output, in order to lessen the load on the main station during times of maximum demand. Aside from the battery capacity and output, the electric sub-station must contain, per unit rate of delivery, unit capacity in rotary converters and a little more than unit capacity in transformers, making fully two units of electric machine capacity per one of output. Rotary converters are more expensive per unit of output than direct-current dynamos, while transformers are less so, making the machinery equipment for electric sub-stations about twice as expensive as the dynamos of a gas-driven plant for equal output.

Considering the additional requirement for batteries at electric sub-stations over that at gas-driven plants, and the double charge for electrical machinery, the total internal equipment of electric sub-stations and of gas-driven plants may be taken as about equal in cost for the same output. The local distribution system from each kind of station should cost substantially the same. The electric generating station with steam-boilers, high grade engines, dynamos, transformers, and high-pressure transmission lines, delivers not more than ten per cent of the energy contained in coal to the sub-stations, and derives a return only on what the sub-stations send out to consumers. In contrast, on the other hand, is the gas-plant and pipe system, distributing in water-gas fully 60 per cent of the contained energy in coal and more than 90 per cent of the energy in the oil consumed. Considering only the efficiency in transforming the energy of coal for each case, the gas-driven electric plant delivers $0{\cdot}60 \times 0{\cdot}20 \times 0{\cdot}90 = 10{\cdot}8$ per cent of the energy of coal as electric current, while the electric sub-station at its best can include in its output not more than $0{\cdot}75 \times 0{\cdot}15 \times 0{\cdot}90 \times 95 \times 90 = 8{\cdot}6$ per cent of the energy in coal consumed in the boiler-furnaces. These figures are based on efficiencies of 0·60 for the water-gas process, 0·20 for gas engines, 0·75 for steam-boilers, 0·15 for steam-engines, 0·90 each for dynamos and rotary converters, and 0·95 for large-station step-down transformers. No account is taken of the small losses in gas-mains and high-pressure electric lines from main to electric sub-stations. A much larger portion of the energy of coal can be transmitted through a gas pipe than through an electric cable, and the best locations for the generation of electric currents are close to the areas to be served.

PARIS EXPOSITION NOTES.

The work of installing the different exhibits in the annex to the Paris Exposition, at Vincennes Park, has been somewhat behindhand, but at the present time the park contains a series of buildings in which a number of exhibits of different kinds are being prepared. One of the most important of these is the building devoted to the Transportation section, this being an annex to the main building in the Exposition grounds. It contains the exhibits of locomotives, railway material and electric traction, and a considerable space has been allotted to each of the principal nations; France, Germany, England, the United States, Russia, etc., have important exhibits which include locomotives of different types, electric cars and trucks, air brakes, etc. In the Austrian section the Ganz Company has an electric car truck with two 25 horse power motors, and the Société Electrique of Winterthur, Switzerland, has an electric motor car of the type used on the inclined railway of Lyons. An electric locomotive of considerable size is that constructed by the Ateliers du Nord de France, the electric material being furnished by the General Electric and Thomson-Houston Companies. In the American section, the J. G. Brill Company, are putting in an exhibit of car trucks with and without car-bodies. The American Air Brake Company has a large exhibit showing its system, and a number of other exhibits are now being installed. When complete, this building will contain one of the most interesting collections of the Exposition. Near by is the section of ground allotted to the United States—in which several buildings and pavilions have been erected. The largest of these is the Machinery Hall, a long building with a main aisle and two side passages, giving a considerable floor-space for the different exhibits. The motive power for the machines was to have been furnished by a Ball engine and a dynamo of American make; the engine is now in place, but the dynamo is lacking, as it was sent on the "Pauillac." In place of this set, a Willans engine of the upright type and a Bullock dynamo of 150 horse power were brought over from England and rapidly set up. The different machine tools are run by small electric motors of different makes averaging 15 horse power. A large collection of American machine-tools is to be seen here, including lathes, planers, drill-presses, etc., of improved models; the Brown & Sharp Company has an interesting exhibit of tools, dies and gauges, and the Ingersoll-Sergeant Drill Co. show a number of air-compressors and drills. An overhead electric crane of the Shaw pattern has been installed in the building. Near by is a fine pavilion erected by the McCormick Company for its exhibits of agricultural implements, and another handsome structure has been built for the American bicycle exhibits; a number of these are already in place, but the building is not yet open to visitors. A number of windmills of American types have been erected in the section, and one of the interesting features is an oil derrick. Not far from the United States section is a building erected for various types of small engines, and here have been installed a number of gas and steam engines of various makes. Another building contains the Acetylene exhibits, and a few of these are already in place. In this part of the grounds is the Automobile building, which is to contain the vehicles of different countries, and in the neighborhood is a vast bicycle track of oval shape with an extensive series of tribunes; it is called the Vélodrome Municipal, and will be used for the numerous bicycle events which will take place during the season, in which the champions of various countries are to be represented. In the section allotted to the Army and Marine, special provision has been made for an exhibition of carrier pigeons. Near this is the Aerostatic park, which will have the necessary buildings for the balloons; here a number of ascensions and contests have been arranged for, and the most recent improvements in the art of ballooning will be shown. A space has been set apart for an extensive collection of agricultural machines, for which sufficient room could not be provided in the Champ de Mars. The groups of horticulture, aviculture, athletic sports, etc., have spaces assigned them. On an island in the center of the Lake Daumesnil is situated the Forestry building, which is an annex to that of the Exposition. A large tract of ground has been devoted to the agricultural and stock exhibits, which are in charge of the Minister of Agriculture. An interesting feature is a number of groups of workmen's houses, which occupy a considerable space; they are built after various models by France, Germany, Austria, Switzerland, etc., and show the most approved construction in wood, brick and other materials. On the main automobile track around the lake has been erected a line of iron poles supporting a double overhead wire for the use of the new system of electric motor wagons constructed by the Trolley Automobile Company.

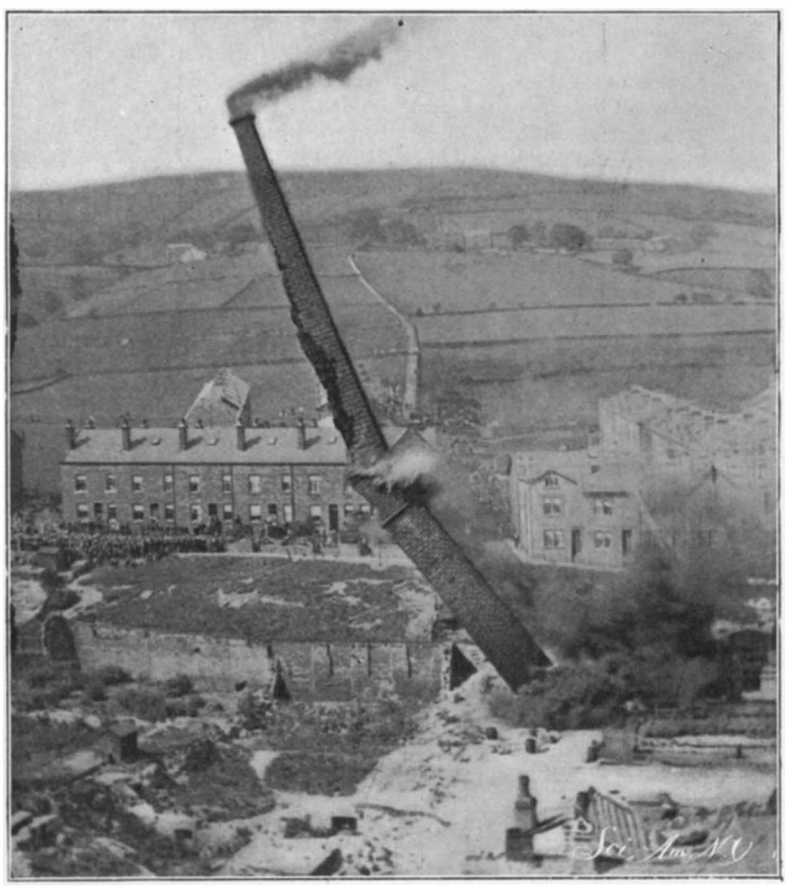
FELLING TALL CHIMNEYS.

The demolition of a lofty chimney, when accomplished in the same manner as it was erected, that is, brick by brick, is a tedious, protracted, and expensive process. But in England, a much more effective, quicker, and cheaper method of bringing a chimney to the ground is in vogue. By this process, a chimney two or three hundred feet in height, that occupied several months in its erection, and which may weigh several thousand tons, is thrown down in a few days at an insignificant expenditure of labor and money. Yet nothing could be simpler than this special process of demolition. It briefly consists of removing the greater portion of the base of the chimney; substituting thick wooden underpinning for the masonry, and then firing the props, which in time burn through, with the result that the chimney collapses *en bloc*.

This method of chimney felling was devised by a Mr. James Smith, residing at Rochdale, a suburb of Manchester, who has overthrown nearly a hundred chimneys in this manner in various parts of England and the Continent of Europe, and in every case without the slightest mishap. Some of these chimneys were among the largest in existence.

In felling a chimney, the stack is first thoroughly examined and careful notes made as to its height, weight, and condition. A survey of the surroundings is then made to ascertain which is the best direction in which to overthrow the structure, and so long as the available area which is to receive the mass is a little more than the length and breadth of the stack, it is sufficient. Having determined upon the direction of the fall and the available area to receive the stack, an incision is made in the center of the chimney at a height of five or six feet from the ground, facing the direction in which it is to fall, and corresponding cuts are made on each of the sides. As the bricks are removed, an underpinning of 6 × 6 timbers is inserted, the work being carried on until about two-thirds of the base of the stack has been so treated. By this time the stack usually is listing over slightly in the direction in which it is to fall, the list being an indication that the chimney is resting almost entirely upon the underpinning. At the same time on the reverse side of the chimney there will appear a slight crack in the masonry. The underpinning is carried on until this fracture appears, for unless the greater part of the structure rests upon the supporting posts, the direction of the fall can by no means be predicted with certainty.

The gap made in the base of the stack must be of sufficient width to cause the structure to drop and telescope when falling. If only a narrow gap were made, the stack would simply pivot on its base and come down intact, measuring its length on the ground; but as it is desired to concentrate the debris, a sufficient gap is made at the base to insure that as the stack leans to its fall it will drop a few feet vertically *en masse*, the jar thus given to it causing the mass to crumble upon itself. As soon as the underpinning is complete, a fire of highly inflammable combustibles is built up, and the props are thoroughly saturated with oil and covered with pitch and tar. On the occasion of the felling of a stack at Preston, which was 250 feet in height and weighed over 3,500 tons, there was consumed in burning out the underpinning 6½ tons of coal, 4 tons of pitch, 40 sacks of shavings, 108 gallons of tar, and 126 gallons of paraffine. The burning of the props has to be most carefully watched, since it is necessary that they all collapse at the same time to insure that the chimney will fall in the desired direction.



FELLING A 200-FOOT STACK BY UNDERPINNING AND BURNING.

The underpinning was a most laborious process, since it occupied no less than a fortnight's hard work. To perform the same operation on an ordinary chimney is a matter of only a few hours, so a very adequate idea may be formed of the strength and solidity of the structure. The masons experienced exceptional difficulty in removing one or two of the stones, which weighed no less than 2¼ tons each, while 16 tons of masonry in all were removed and fifty props inserted in their place. This chimney came down very quickly after the props were lighted, the fall taking place in 10½ minutes, whereas it usually takes half an hour to burn out the supports. Our photograph was secured as the chimney fell over, and it shows the shaft in the act of telescoping.

The largest stack ever brought down by this method was one at a large paper mill at Manchester. It was no less than 270 feet in height, was octagonal in shape, and measured 90 feet in circumference at the base. More than 1,000,000 bricks were employed in its construction, 100,000 of which constituted the foundations. The total weight of the structure was nearly 4,000 tons.

The process above described is that which is always employed when the stack has a large space into which to fall, be it circular, square, or octagonal in shape. When, however, it has to fall into a more limited space, it is a much more difficult operation, since the whole of the stack has to be subverted and has to rest entirely on the wooden props. Then again the burning of the fire necessitates assiduous watching in order to insure that they all collapse simultaneously. If the operation is successful, the chimney does not topple over, but telescopes perpendicularly into a large heap over its original foundations.

BASE OF THE STACK UNDERPINNED, AND FUEL LAID READY FOR BURNING.

We present illustrations of the felling of a shaft at Mytholmroyd in Lancashire, which was erected in 1833 at a cost of $5,000 and was 200 feet in height. It had been sadly damaged by the agencies of wind and weather, and sooner than repair the chimney it was decided to bring it down. It would have amply repaid any expense devoted to its renovation, however, since it proved to be one of the most solidly constructed shafts in the country. The base was square in section and measured 11 feet each way.

Black Diamonds.

The only two regions from which black diamonds are taken seem to be the Cape of Good Hope and the province of Bahia in Brazil. The black diamonds are divided into two varieties, known as carbons and borts. The first of these is a variety of diamond which occurs in irregular crystals, having a somewhat granular structure without possessing a distinct cleavage. Its hardness is at least as great as that of the diamond, although its density is inferior on account of a slight porosity; it has a resinous luster and is grayish or black in color. The "bort," on the contrary, is somewhat spherical and does not present the irregularities shown by the "carbons;" it is grayish or black and somewhat translucent, taking the form of round masses with a rough surface or one presenting a confused crystalline structure. It is only within the last ten years that the black diamond industry in Brazil has assumed any considerable importance; it is utilized in the manufacture of rock-drills, etc. The demand is constantly increasing, and for this reason the price remains high. The region where the black diamonds are found is about one day's journey from Bahia, by boat to San Felix and by railroad to Bandeira do Mello; this is also a diamond-producing district. The most productive region is found beyond the river Paragason, about two days' journey by mule. It is probable the black diamond is to be found in all this region, but on account of the primitive methods of extraction the only places from which they are taken are the bed of the river and its tributary the San Antonio, and from the sides of the Sierra des Levras. The carbons are found in a kind of gravel consisting mainly of quartz pebbles mixed with ferruginous clay and resting on a clay stratum.

A spot is chosen in the bed of the river where it is not more than 20 feet deep and where the current is not too rapid; a long pole is planted, down which the native descends, being provided with a sack whose mouth is stretched open by an iron ring. The clay is scraped from the bed of the stream and the sack filled with gravel; it is brought up and taken to the shore, the sacks being stored out of reach of high water. This operation is carried on each day for the six months of the dry season. At the commencement of the rainy season, when the search is suspended on account of the current and the great depth of the river, the gravel is washed and examined for carbons. The divers are quite skillful and can remain under water for more than a minute and a half. The parts of the river having a great depth are not worked; here dredges or diving apparatus could be used to advantage. Another method of extraction consists in perforating the sides of the mountain along the shore, and a number of tunnels have thus been made for the extraction of gravel containing diamonds and carbons. The work is carried on during the dry season, and in the rainy season the gravel is washed in cradles or by similar methods. The carbons are found in dimensions varying from a grain of sand to crystals weighing 975 carats; the largest was discovered in 1894 and sold at Paris for 100,000 francs. The size preferred is that weighing from one to three carats, as the large masses must be broken, with considerable loss. The carbons are used principally in the construction of rock drills, being disposed on a steel crown in circles or rows; their price is naturally high, this resulting in part from the imperfect methods of extraction employed. The buyers are found chiefly at Bahia, and have representatives in the mining region; the price is variable, and averages $22 per carat.

In Vienna, telephone booths are furnished with napkins bearing the inscription, "Wipe, if you please." The napkins are changed frequently, and this undoubtedly serves to keep the mouthpieces of the transmitters in good sanitary condition.

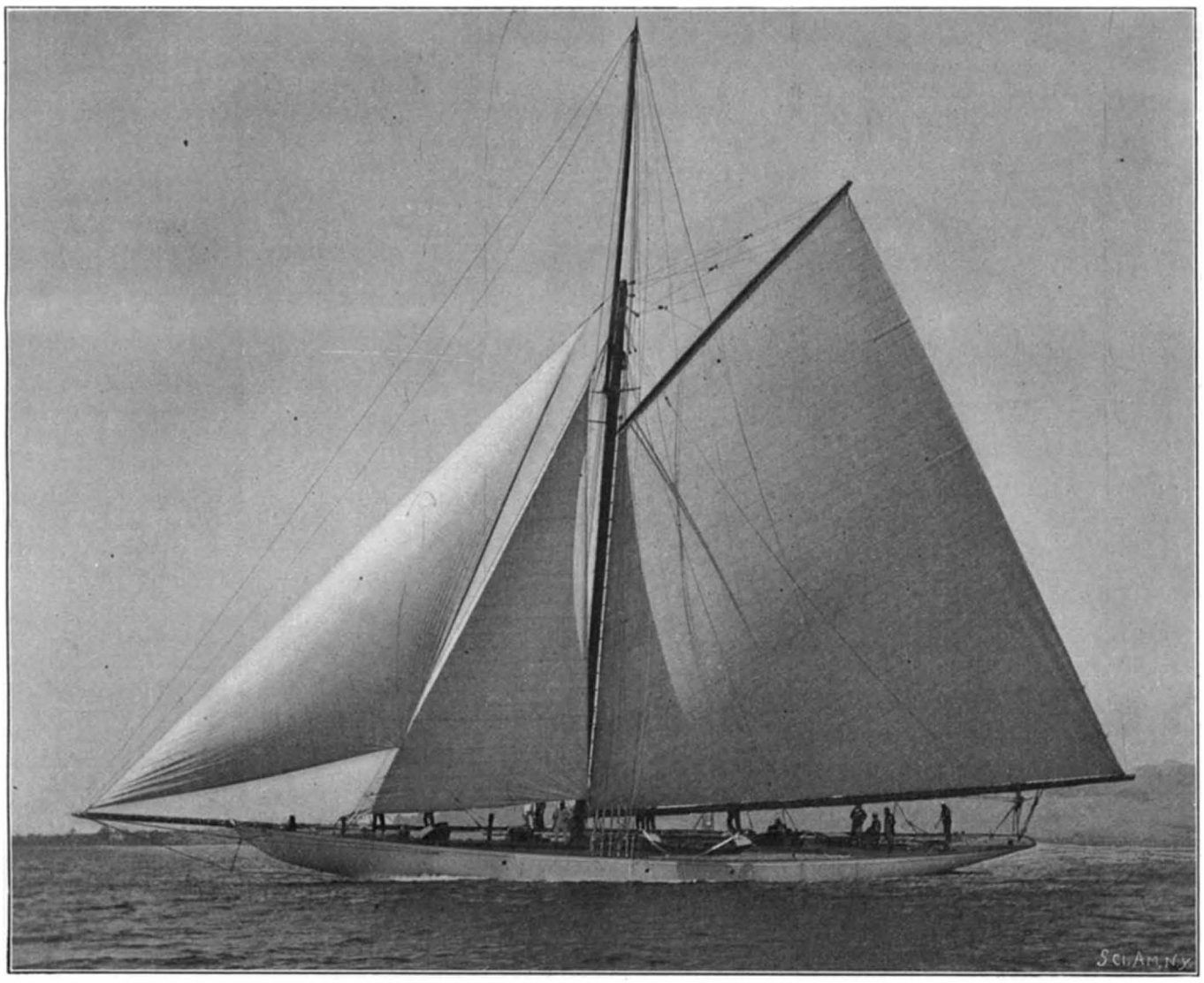
THE HERRESHOFF 70-FOOT YACHT "MINEOLA."

Although there will be no race this season for the America cup, the enterprise of a few of our leading yachtsmen will be responsible for a remarkably interesting series of races, which will form a connecting link between the America cup races of the season of 1899 and those which are destined to take place in 1901.

The 70-foot yacht "Mineola" is the first of four identical sloops which have been constructed this spring by the Herreshoffs at their Bristol yard. She was also the first of the four to spread her canvas, and the accompanying illustration shows this beautiful craft as she appeared during her trial trip. The other three yachts are "Rainbow," owned by Cornelius Vanderbilt; "Virginia," built for W. K. Vanderbilt, Jr.; and a yacht for H. P. Whitney, which has yet to be named. The four yachts are so completely identical that the illustration of the "Mineola" will stand equally well for any one of the other three.

The general dimensions of the "Mineola" are: length on water line, 70 feet; length over all, 106 feet; beam, 19 feet 8 inches; and draught, 14 feet. Although she so greatly resembles the American champion of last season that she might well be mistaken at a distance for the larger yacht, her construction is neither so light nor so costly, and there are differences in sail plan which will readily be noticed by the yachting "sharp." As a matter of fact, she is a compromise between the racing cruiser and the out-and-out racer, possessing the comfort and handiness of the one with something of the speed of the other. Hence we do not find the extreme features of the hollow mast and spars, metal plating or exaggerated sail plan of the highly developed racing machine. The vessel is of composite build, the frames and deck beams being formed of nickel-steel bulb angles, and the deck planking and sheathing being of wood. The mast is 78 feet long; topmast, 47 feet; main boom, 75 feet; gaff, 42 feet 9 inches; spinnaker pole, 58 feet; while the bowsprit measures 18 feet outboard. The sail area, as measured for racing, will total some 6,000 square feet. It will be noticed from the illustration that the sails are to be of the cross-cut pattern, which has been used almost exclusively of late years on American yachts.

As compared with the "Columbia," the "Mineola" has the same long overhangs, graceful shear, rising to a somewhat lofty bow, and characteristic beauty of lines. Under water the lateral plane has not been cut into quite so far, and the body is somewhat fuller. The mast also is set further aft, and the bowsprit and main boom do not project relatively so far outboard. The four vessels afford an excellent school for practice, and will serve to keep our skippers and crews, both professional and amateur, in trim for the international season of 1901, which promises to be most exciting in the history of the America cup.



Photograph by Frank H. Child, Newport, R. I.

One of Four Identical Boats Built by Herreshoff for the Season of 1900.

THE 70-FOOT YACHT "MINEOLA," OWNED BY AUGUST BELMONT.

The latest information from Glasgow is to the effect that Watson, the designer of the "Thistle" and the "Valkyries," will be given the next opportunity to draw the lines of an America cup-challenger. The "Shamrock" is to be somewhat remodeled and used as a trial boat for the new boat, performing in this respect the duties which were so well carried out by "Defender" during the preliminary tuning up of "Columbia." All things considered, the Watson boats were more successful than the "Shamrock," "Valkyrie II." making a much bolder bid for the cup than the lighter and more costly Fife creation. It will be interesting to see what the designer of the "Valkyries" can do when he is given a free hand as to materials and cost. That he can match the best efforts of Herreshoff we do not believe; but that he can come much nearer to it than Fife is quite probable.

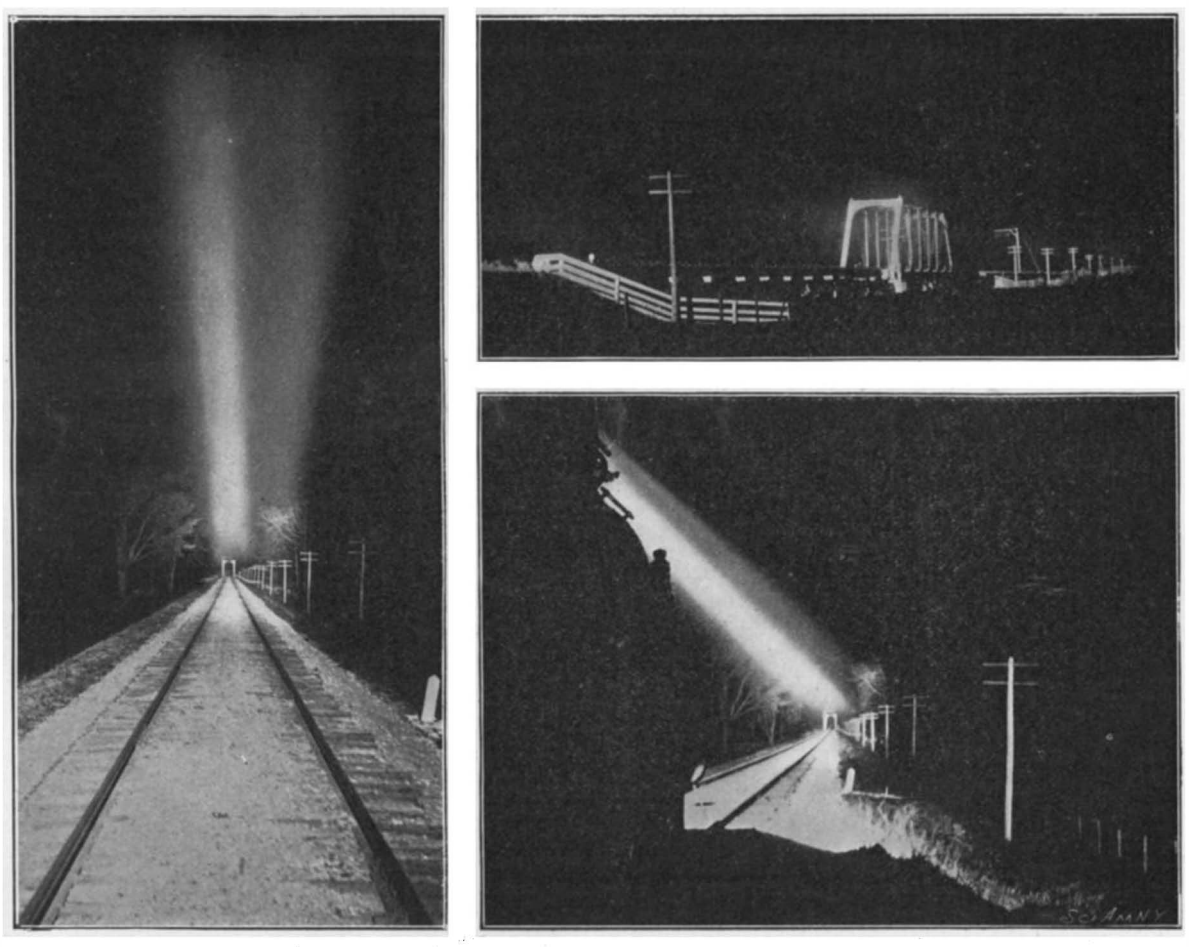
ELECTRIC HEAD LIGHT EFFECTS.

BY D. ALLEN WILLEY.

The electric headlight, whose brilliant illumination is well portrayed in the remarkable group of photographs herewith reproduced, is in extensive use in some of the Southern States, and is being freely adopted in the West. Among the railroad companies which have favored it are the Central of Georgia and the Cincinnati, New Orleans and Texas Pacific. In many portions of the Southern and Western States the railroad tracks are not separated from the adjoining fields and grazing lands by fences, and it is a common practice for the farmers to allow their live stock to run at large. As a result the railroad companies are compelled to pay large sums annually for cattle and hogs which have been killed by passenger and freight trains, and a number of serious accidents have occurred, due to derailment. The Central of Georgia Railway traverses a very large area of low-level country, and until the adoption of the electric headlight the engineers were obliged to use the greatest caution in running at night, and on some occasions it has been necessary to stop the trains and send men ahead to drive live stock from the track. Engineers were under orders to run trains slowly through the grazing districts, as on a dark night they could see but a few hundred feet of the track ahead, the oil headlight being of very limited range.

By using the electric headlight the length of vision has been greatly increased, objects being plainly perceptible at a distance of over half a mile under favorable conditions of the atmosphere. As will be noted by the accompanying photographs, such small objects as bridge warnings, posts, etc., along the right of way are distinctly visible at a distance of several hundred yards, so intense is the illumination; while a broken rail or a displaced switch would be visible in time to mitigate, if not entirely avert disaster. The photographs reproduced were taken by the light of the electric headlight along the line of the Peoria, Decatur and Evansville Railway. The negatives were exposed for about forty minutes.

The light furnished is of the arc type, requiring carbon burners. The electricity is generated by an ordinary dynamo, operated by a Pyle compound



These photographs were taken with locomotive at 1,000 and 2,500 feet from bridge.

ELECTRIC HEADLIGHT PHOTOGRAPHS—EXPOSURE, 40 MINUTES.

steam turbine of 1½-horse power. The light with a good reflector equals about 8,000 candle-power. The dynamo and turbine are attached to the top of the boiler between the headlight and the smokestack. Steam is introduced into the turbine from the main boiler at the will of the engineer, the mechanism of course being operated from the cab. A carbon can be used continuously for about eight hours, so that it is unnecessary to feed the lamp for that length of time. In connection with the burner an ordinary locomotive reflector is used, the combination producing the brilliant illumination shown in the illustrations.

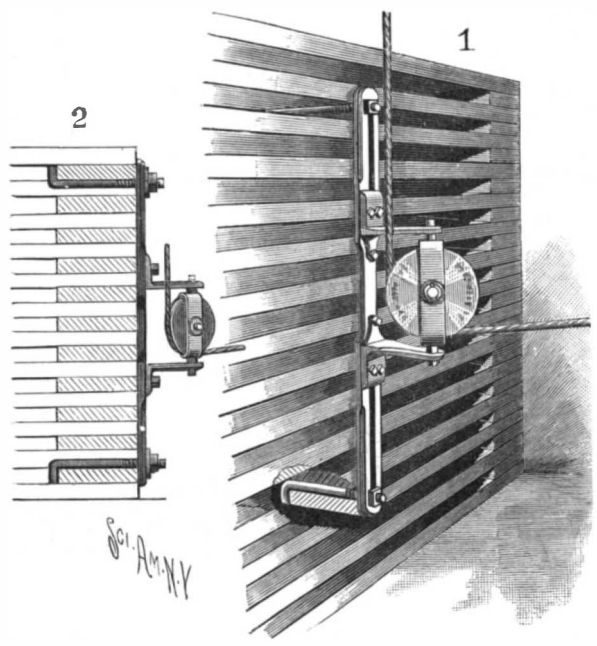
SOME UNIQUE ATTRACTIONS OF THE PARIS EXPOSITION.

The Paris Exposition is now practically completed, with the exception of a few minor details, and visitors are beginning to flock to it in large numbers. Its vast size is accentuated by being divided up into five or six different sections which require the visitor to make long journeys, but this has fortunately been obviated as far as possible by excellent means of intramural transportation. The great palaces devoted to the more important subjects may well take up all the time of the visitor for months, but there are many interesting exhibits in the smaller and less well-known buildings, and the amusement features, which are already attracting large numbers, are not to be neglected. We will glance briefly at a few of the less well-known buildings and some of the concessions.

The Palace of Navigation is constructed on the banks of the Seine at the left of the Pont d'Iéna, facing the Trocadéro, and forms a pendant to the Palace of Forestry, Fisheries, etc. Both buildings are the work of the same architects, MM. Tronchet and Rey. The lower story is composed of a series of horseshoe arches which form a colonnade, and above is a story composed of somewhat extraordinary architectural details. Parts of the decoration leave no doubt as to the purpose to which the building is to be put, one side ending in a prow of a galley, and above the building, in the center, may be seen a lighthouse, which, while it really belongs to the Pavilion of Navigation, is on an annex containing the German exhibit. The interior of the Palace of Navigation consists of a grand hall surrounded by galleries. The exhibits are models of vessels of all kinds, small boats, canoes, motors, anchors, chains—in fact everything which has to do with the navigating of either steam or sailing ships, including instruments of precision for making calculations, devices for saving life, etc.

The Celestial Globe is probably the most imposing from outward appearances of any of the concessions. It is on the banks of the Seine, near the Champ de Mars, and occupies a corner between two railroad stations. It is not in the grounds proper, but is connected with them by a bridge which crosses the Avenue de Suffren, and it was this bridge which collapsed a few weeks ago, resulting in several deaths. The sphere is 151 feet in diameter and rests on four stone pillars. It is surmounted by a terrace 197 feet from the ground. The exterior is decorated with large astronomical and mythological figures which are illuminated at night. In the interior electrical elevators and staircases convey visitors to a second sphere, the diameter of which is 115 feet, and in it is the center of this artificial planetary system. Here visitors will see the sun shining in the firmament, moving on the ecliptic, the stars, planets and even comets moving through space. The latter are represented by electric balls of different shape and size and changeable colors. In the center is the earth, 26 feet in diameter, revolving on its axis. There is seating room for a hundred spectators at a time, and they will be carried from west to east. The moon turns around the earth, accomplishing the phases of its monthly revolution. At certain times the phenomena of an eclipse will be visible. All the celestial movements are effected with scientific precision, and a grand organ is played mechanically, special music having been written for the occasion by M. Saint-Saëns. The staircase in the interior leads up from the terrace on which the Globe rests by a double track, forming an oblique circle and representing the zodiac. There are, of course, restaurants and minor attractions connected with the affair.

Another interesting amusement or concession is the "Tour de Monde," which is situated near the Eiffel Tower, and a little way back from the Seine. The interior is composed of bits of architecture of various peoples, and here we see specimens of pagodas, towers, minarets, etc., and yet the whole is blended with such skill that the effect is not displeasing. The bizarre



A LUMBER-HOISTING PULLEY.

and grandiose architecture of Indo-China is particularly noticeable. In the interior there is a small theater where scenes of various countries are represented by exotic actors, and there is also an immense panorama forming an ellipse, picturing scenes of various countries served by the Messageries Maritimes, including Greece, Turkey, Egypt, the Indies, China, Japan, South America, etc.

The section of the Exposition on the right bank of the Seine, between the Trocadéro and the river, is devoted to various colonies, including Algeria, Tunis, Senegal, the Soudan, French Guiana, Dahomey, Ivory Coast, the Congo, Indo-China, New Caledonia, Madagascar, etc. The French colonies occupy half of the garden of the Trocadéro, while the other half is given up to buildings of other powers. The grounds of the Indo-Chinese section comprise four distinct pavilions —Tonkin with an Annamite theater, a Cambodian pagoda, a pavilion devoted to the products of the colony, and also a building for the display of forest products and the rare essences of this country. In the grounds is a heroic Chinese god with the banyan tree, as shown in our engraving.

The Siberian building is of imposing size, and is constructed on the grounds of the Trocadéro. It is a picturesque assemblage of pavilions, and it is filled with exhibits from the territory served by the Trans-Siberian Railway. It comprises pavilions of Central Asia, the Caucasus and the Siberia of the extreme north. There are also panoramas showing scenes on the Trans-Siberian Railway and a panorama of the coronation of the present Czar, by M. Gervex. The Compagnie Internationale des Wagons-Lits exhibits a series of sleeping cars, restaurants, and luxurious service on the Trans-Siberian Railway. The exhibits of Russian goods are most important.

ONE OF THE ENTRANCES TO THE UNITED STATES EXHIBIT.

AN ADJUSTABLE HOISTING PULLEY.

The subject of the illustration which we present herewith is an improved pulley arranged for convenient attachment to the side of a pile of lumber, to guide the hoisting-rope and to hold it in proper position. The pulley was devised by its inventor, Mr. John A. McGarry, of 1100 South Lincoln Street, Chicago, Ill., to be used in connection with a hoist of his invention.

The device comprises a bracket-plate having at each end elongated slots which receive bolts, the ends of which are hooked to engage the inner edges of the corresponding pieces of lumber, as shown in Fig. 2. From the front of the plate bracket-arms project. A grooved pulley has trunnions mounted to turn in the bracket-arms. The pulley, it is evident, has a swivel connection with the bracket, so that the hoisting-rope can readily turn the pulley, according to the sidewise pull exerted by the horse or other power employed to raise the lumber to the top of the pile.

The bracket can be easily attached to any part of the pile of lumber. The elongated slots and hooked bolts enable the device to be vertically adjusted to bring the lower or horizontal part of the rope in proper position relatively to the animal. The device, although primarily designed for hoisting lumber, is evidently capable of being otherwise employed.

Plague in San Francisco.

San Francisco has just been suffering from a panic on account of an alleged outbreak of bubonic plague. The local Board of Health, reinforced by United States quarantine officials, besides other experts of the disease, claimed that ten well authenticated cases occurred, and that all were fatal in their results. All of these were among the Chinese of the lowest class, just those among whom the disease, on account of their filthy habits and the squalid surroundings under which they lived, was certain to appear.

It is denied by many that the conclusions of the board were in any degree justified, or that any cases of the plague have really occurred at all.

In any event the belief that San Francisco is a plague-infested city has circulated through the country and is rapidly and seriously affecting business.

Chinatown, comprising twenty blocks, in which more than 20,000 of the Orientals live, for the most part, in crowded and filthy tenements, is now surrounded by guards, and none are allowed to enter or depart.

Ropes were stretched across the streets and the attempt was made to close all communication with the outside. The streets were deserted, and the Chinaman, unable to work at his usual avocations, spent his time at the opium pipe, or in gambling away the hours. At least 10,000 Chinamen were in danger of destitution. This contingency the city stood prepared to meet.

It is not believed that a serious epidemic is possible in a climate so cold as that of the San Francisco peninsula, where the temperature rarely ranges above 70°, and the surrounding water is so chilled that sea bathing is impossible to the average person.

Every precaution was taken to prevent the contagion from extending to the interior, where conditions are more favorable for its spread. Were it not for the ignorance and utter indifference of the Chinese in matters calling for the interference of the whites, the task of stamping out plague germs would be comparatively easy.

The disposition of these people to conceal suspicious cases of sickness constitutes the most serious difficulty to be overcome.

Correspondence.

The "Shadow Bands" of the Solar Eclipse.

To the Editor of the SCIENTIFIC AMERICAN:

I went to Pinehurst, N. C., to view the solar eclipse on the 28th ult. Our position was close to the central line of the shadow path, and we saw all the phenomena successfully, the sky being perfectly clear.

I was particularly interested in the "shadow bands," those curious little undulations of light and shade which appear for a few moments just before and after totality, and whose cause does not appear to be very well understood as yet. It may interest some of your readers to know just how they appeared, and perhaps I may be allowed to suggest a possible explanation of them.

Immediately in front of the house from which we were watching the eclipse, there was a broad level walk of whitish sand. About five minutes before totality, we began to notice on this walk a peculiar appearance as of very fine wavy lines moving in the direction of the eclipse, at the rate of perhaps ten or twelve feet a second. The lines or shadows were at right angles to the direction of the eclipse, and did not seem to be continuous, but broken and somewhat irregular, with an uneven, rippling motion. If you will imagine a shallow pool of clear water, perhaps a foot deep, with a white sandy bottom; and further imagine the surface of this pool to be ruffled by a fresh breeze, causing a progression of ripples six or eight inches apart, then the shadows of these ripples on the bottom of the pool would be more similar to the appearance of the "shadow bands" than anything else I can think of. They differed considerably from the representations I had seen of them in previous eclipses, when they are generally figured as broad alternate bands of light and shade. I should say that "shadow lines" would be a more appropriate designation than "shadow bands."

As to the cause of the phenomenon, the fineness and closeness of the lines makes it evident that it must be sought for close to the earth's surface. Such delicate shadows could not be cast by any object very far away. As I watched the motion of these curious lines, I could hardly resist the impression that they were caused by the undulations of a stratum of heated air passing directly above our heads. In point of fact, it was getting so cold at this time that we had to put our wraps on. After totality the same appearances were noted.

The governmental eclipse party at Pinehurst had at their observatory a large white sheet stretched at an angle with the earth's surface and directly facing the sun. One or two observers were detailed to watch the "shadow bands" on this, but they were only faintly seen, not as well as on the level ground, and I was told by some that they saw them distinctly on quite rough ground. This would indicate that whatever caused them, they moved on a level with the earth's surface rather than on a line with the moon's motion across the sun.

The conclusion I arrived at was that the passage of the moon shadow caused an undulatory motion in the atmosphere close to the earth, whether thermal, or electrical, or mechanical, I am not prepared to say. This wave motion would naturally be slower than the speed of the shadow, just as waves upon water are slower than the wind which produces them, and the slender crescent of the almost eclipsed sun would throw much finer shadows of these undulations than if his disk were wholly unobscured.

A. W. COLGATE.

Morristown, N. J., June 7, 1900.

The June Building Edition.

The SCIENTIFIC AMERICAN BUILDING EDITION for June has many interesting articles and engravings. "Architecture and Citizenship" is by Prof. A. D. F. Hamlin. A summer residence and casino at Sound Beach, Conn., are very attractively shown. The great dining hall of the "Breakers," at Newport, R. I., is illustrated by a full-page engraving. "An Artist's Home in Oakland, Cal.," illustrates the unique dwelling house which was built by Mr. Peano, instructor of sculpture in the Lick School of Mechanical Arts at San Francisco, and most of the details are the handiwork of his students. There are as usual a number of moderate-priced houses, and in each case the floor plans are given and there are some interiors.

TARDY justice is at length to be done to another of the many martyrs of science in the person of Prisse d'Avennes, the discoverer of the famous maxims of Ptah Hotep, which has been claimed as the oldest book in the world, says Biblia. Prisse d'Avennes was a munificent donor in his time to the museums of Paris, and most patriotically refused all offers from other nations to work for them as an archæologist when the trade of exploring was more highly paid and less crowded than it is to-day. He died in poverty at the age of seventy-two, and his grateful country has now named a street in Paris after him and proposes to place his bust in the Egyptian Museum of the Louvre.

Science Notes.

In the SCIENTIFIC AMERICAN for February 24, 1900, we illustrated the remarkable twins Rosalina and Maria, who were born joined together in much the same manner as the Siamese twins. An operation was recently successfully performed upon them at Rio Janeiro, and they were cut apart.

The Brooklyn Institute of Arts and Sciences has broken ground for the central section of the Museum on the Eastern Parkway. The new section will have a frontage of 140 feet on the Parkway and a depth of 122 feet. It will be four stories in height, and the ground floor will have an auditorium capable of seating 1,250 persons.

A new species of petrel has been discovered on the island of Kauai (Sandwich Islands) by a Stanford University graduate, Mr. A. Searle. He has also found on the same island a new species of sea gull. He is going to Guam to explore that island and to make a collection of birds and fishes for the famous Bishop Museum of Honolulu.

A section of the tree which was over David Livingstone's grave has been received by the Royal Geographical Society of London, and placed with the other Livingstone relics in its possession. An iron telegraph pole now marks the spot where the great African explorer breathed his last. The huge block of wood was carried on the shoulders of the natives from the heart of Africa to the coast.

The curved pages of an ordinary book are injurious to the eyes. Mr. F. G. Murphy shows that the curved page causes a constant change of the focus of the eye as it reads from one side to the other, necessitating a continued effort on the part of the ciliary muscles The light also falls unequally upon both sides, further interfering with a continued clear field of vision. He, therefore, suggests that the printed lines run parallel to the binding instead of at right angles to it, so that all parts of the line would be at an equal distance from the eye and be equally lighted.

The National Academy of Sciences of the United States has recommended to the trustees of Columbia University that the Barnard medal for meritorious service to science be given to Prof. Roentgen for the discovery of the X-rays. The award will be made at the Commencement of the University on June 13. The gold medal was established by the provisions of the will of the former President of the University, the late Prof. F. A. P. Barnard. It is awarded every quinquennial period to any person who shall have made such discovery in physical or astronomical science as in the judgement of the National Academy of Sciences shall be esteemed most worthy of the honor.

For several months past experiments have been conducted at Sassari, in Sardinia, by Dr. Fermi, Dr. Cossul-Rocca, and Dr. Lumbau, for the purpose of ridding that town of the pests of mosquitoes with which it is overrun. The doctors effectually destroyed the larvæ by distributing vast quantities of petroleum in the swamps and other spots where the insects bred, and the mosquitoes were exterminated by chlorine and other powerful destructive chemicals. The doctors in their report consider it possible to free any town infested with mosquitoes by this means, provided it is not too unfavorably situated. It is an economical remedy, costing only about $250 per annum for a town possessing a population of about 50,000 inhabitants.

The Nuova Cimento contains an interesting article by P. Gamba, giving the result of his experiments upon the elasticity of marble. Plates of marble were impregnated with different liquids, and the effect measured. The experiments are best carried out with water, as by drying, the marble may be slowly brought back to its original condition, the curves of deformation being the same before and after the action. The deformation is greater for the wet plate, and the residual effect is also greater; there is thus a considerable increase in the flexibility of the wet marble. Oil, glycerin, and solutions of paraffin give similar results, although the marble cannot be forced from the liquid and brought back to its original state as with water. Petroleum, however, causes no difference in the flexibility. Glycerin gives the greatest effect.

Every soldier in the British Army carries in his haversack what is known as the "Emergency Ration." This consists of a small tin cylinder, similar to a pocket spirit flask, divided into two compartments. One of these is filled with 4 ounces of cocoa paste; and the other contains a similar quantity of concentrated beef (pemmican). As its title implies the ration is not to be used except in the cases of direst necessity, and if consumed in small quantities it will maintain strength for 36 hours. The tin has to be produced at parades and daily inspections, and the soldier who does not display his ration is severely dealt with. The tin must not be opened on any account, except by order of an officer. The ingredients may be either spread upon a biscuit like butter, or boiled up as cocoa or soup. Each tin contains sufficient quantities of the foodstuffs to make four pints of each.

Engineering Notes.

The Baldwin Locomotive Works, of Philadelphia, have received an order from the Egyptian government for twenty locomotives for the Egyptian Railway.

25,816 vessels passed through the Baltic Canal during the year ending March 31, 1899, the aggregate tonnage being 3,117,840; the total receipts amounted to $388,000.

Work on the remodeling of the Grand Central Station, New York, is being carried on steadily. The new waiting-room will be 70 to 190 feet, and a wide concourse will be built across both train sheds between the waiting-room and the southern end of all the tracks. The regular train service has not been interfered with during the alterations.

One of the express trains running between New York and Boston has twin headlights. They focus on the rails a hundred yards or so ahead of the engine at the points where the greatest illumination is desirable, and diverge beyond over the surrounding fields and farmhouses, and enabling the engineer to see along the curves. With the new twin lanterns one arm or the other of the X of light reaches along the curving track.

A Philadelphia bridge building company has obtained a contract for the new steel bridge across the St. Lawrence River at Quebec. The bridge will be 4,000 feet long and 150 feet above the river, thus enabling the largest ship to pass under. It will consist of three spans, two of 500 feet each and the center one of 1,800 feet. The bridge will be 60 feet wide, containing a roadway, four railway tracks and walks on each side.

A plan is now before the Italian Parliament for providing the three southeastern provinces of Foggia, Bari and Lecce with water from Caposele in the Apennines by building an aqueduct 163 miles long with branches that will bring up the total length to 860 miles. The land is very productive, but suffers in summer from drought and malaria. The present water supply of the district is drawn largely from swamps. The projected aqueduct would cost $32,000,000 and would supply 288 towns and villages having a population of 1,800,000.

The special trains on the Siberian railroad certainly possess everything for the comfort of travelers. There is a library, piano, writing conveniences, barber shop, gymnasium, ice water, hot water, dials which indicate the next station and the length of the stop, double windows to protect the passengers from dust and the extreme Siberian cold, and an observation car at the rear. There is no charge for medical attendance, but baths cost one dollar. There are attendants on the train speaking English, French and German. The time from St. Petersburg to Irkutsk is seven days.

United States Consul-General Hunter, at Cairo, Egypt, sends to the State Department statistics of the Suez Canal traffic in 1899, which show that 3,480 steamers, of 9,893,022 tons aggregate, passed through the canal last year, as compared with a total of 3,464 vessels and 9,186,912 tons in 1898. Of the vessels passing through in 1899, 2,207, of an aggregate tonnage of 6,628,767 tons, were British; 378, of 1,051,149 tons, were German; 223, of 591,142 tons, were French; 205, of 438,175 tons, Dutch; and 102, of 255,281 tons, Austrian. Twenty steamers, of an aggregate tonnage of 64,801, flew the flag of the United States.

The British Navy are experimenting with two new varieties of fuel in place of Welsh steam coal. One is a mixture of anthracite coal with some other materials, the nature of which is not divulged, compressed into small blocks, and the other consists largely of Welsh coal residue. Four first-class battleships have shipped several hundred tons of this fuel. The reason for this action is probably due to the fact that the Admiralty sometimes experience great difficulty in obtaining sufficient quantities of the Welsh coal. A short time ago the stock of this coal at Portsmouth was exceptionally low and the question was raised in Parliament as to whether some other fuel could not be discovered that would fulfill the exigencies of the navy with equal satisfaction.

Mr. O. Guttmann has recently made a series of experiments relating to the effect of explosions upon the surrounding air. It has been previously observed that as the air is greatly compressed under the circumstances, its temperature should be raised to a considerable degree; thus a compression of 200 atmospheres would cause an elevation of temperature of 1,060° C. As the explosives used in mines gives pressures of 6,000 to 8,000 atmospheres, the heat thus produced should be sufficient to inflame the gaseous mixtures found in the neighborhood. The experiments made by Mr. Guttmann confirm this hypothesis: Two cartridges of an explosive containing ammonium nitrate were suspended near each other, and the explosion made, a photograph of the phenomenon being taken. The plate shows a luminous appearance at the meeting point of the two waves of explosion, and this may be attributed to the fact that at this point the compression caused the temperature to be raised high enough to inflame the surrounding gases.

A PHOTOGRAPH OF THE SOLAR ECLIPSE.

In our last issue we described some of the eclipse stations, and briefly outlined the results obtained on the occasion of the total eclipse of the sun on May 28. We now present an engraving made from a photograph taken at Wadesboro, N. C., by Paul A. Draper, who was one of the party on duty during the period of the eclipse, at the Smithsonian Institution observatory. The installation included three large cameras for photographing the eclipse; they were placed upon an equatorial axis, and Mr. Draper's instrument was placed on this axis, next to one of the largest instruments. The exposure was 82 seconds, the lens being a Bausch & Lomb symmetrical lens, 5 × 7, rear combination; focus, 13½ inches; stop, F—11. The plate used was of the double-coated, non-halation variety made by Seed. The cap was removed 5 seconds after totality began and was replaced about 5 seconds before it ended. The entire duration of totality at this station was 90 seconds. The photograph was submitted at a meeting of the Smithsonian party held at Washington, D. C., and was pronounced to be an excellent representation of the eclipse. The composite picture which will be prepared by the scientific parties will not be finished for several months.

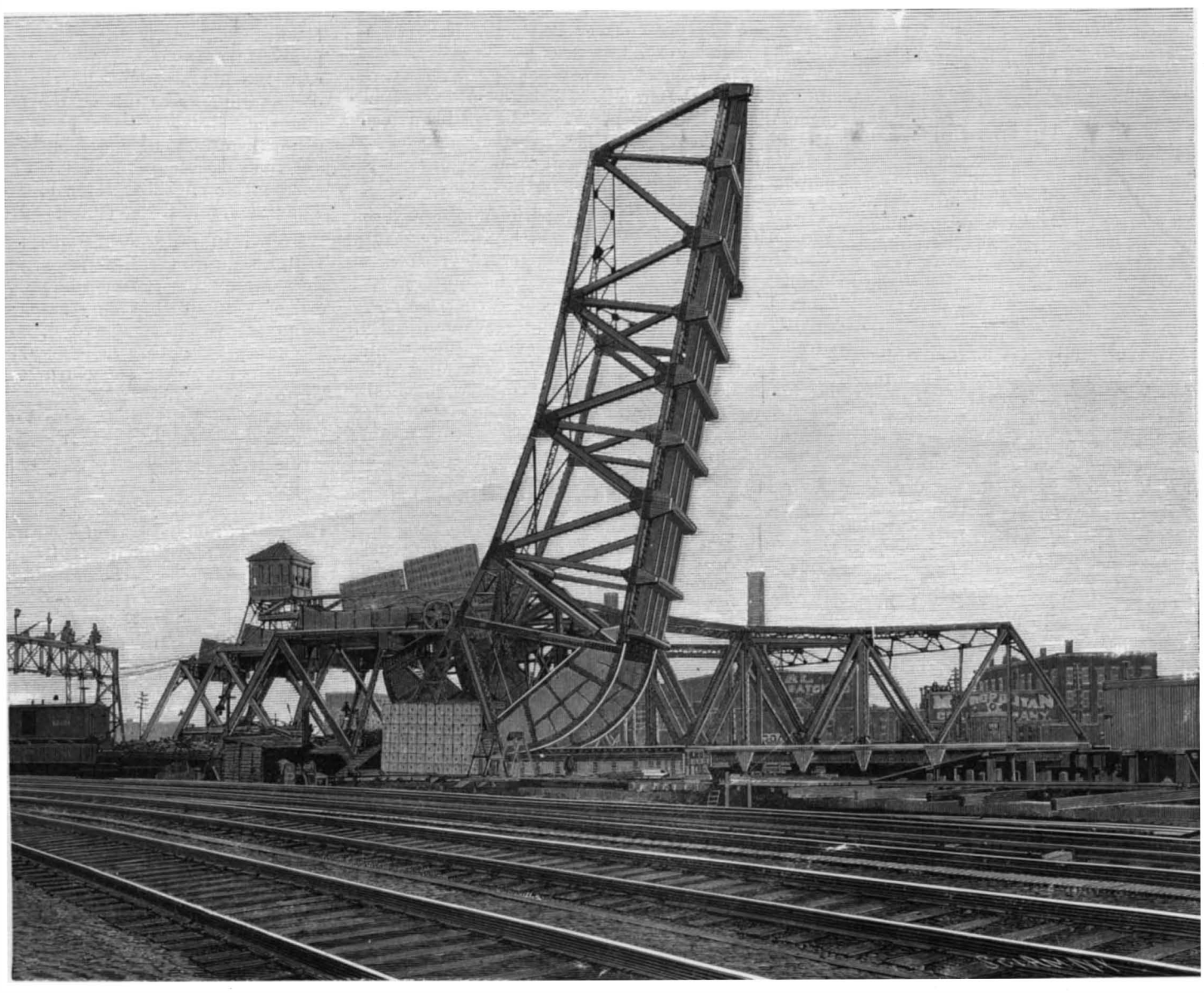
While the corona was a beautiful sight, it was considered by some observers not to be equal to its predecessors. It is said to be fainter than that of 1878 and dimmer than usual; the prominent white places were entirely missing, and the streamers were not quite as active as formerly. This, however, is vigorously denied by other observers.

Photograph taken by a Smithsonian observer at Wadesboro, N. C. Exposure, 82 seconds.

TOTAL SOLAR ECLIPSE OF MAY 28.

ROLLING-LIFT BRIDGE OVER FORT POINT CHANNEL, BOSTON.

The rolling-lift bridge shown in the illustration forms part of the extensive works which have been necessary in connection with the approaches of the various roads which enter the great South Terminal Station at Boston. It serves to connect the Plymouth Division of the New York, New Haven and Hartford Railroad with the terminal yard tracks, several of which are seen in the foreground of the picture. The Plymouth Division tracks cross the channel at an angle of forty-two degrees, and the crossing is made up of three separate lifting trusses, placed side by side with a distance of 29 feet 6 inches from center to center, the total width of the triple bridge as thus arranged being a trifle over 88 feet. Each bridge is raised and lowered independently by a 60 horse power electric motor, the movement of all three bridges being controlled from the operating tower, which will be noticed in the engraving at the rear of the bridges. One of the spans is shown in the fully raised position, while the other two are down. The bridge is of the standard lattice truss type, with inclined posts and vertical hangers. Owing to the fact that the bridge is on the skew, each span contains one long and one short truss, which are respectively 113 feet 10 inches and 83 feet 8 inches long.



ROLLING-LIFT BRIDGE OVER THE FORT POINT CHANNEL, BOSTON.

The counter-weighting of the bridge is accomplished by providing two counter-weight frames, one for each truss, and loading each frame, 99 weights being placed in each frame, those for the heavier truss weighing 1,800 pounds apiece, and those for the lighter truss 1,300 pounds. The total weight in the one case is 644,050 pounds, and in the other 499,300 pounds; while the total weight of the three lifts is 1,143,350 pounds.

The segmental bearings on which the span revolves are struck to a radius of 26 feet and cover a circular arc of 80°. Their faces are provided with segmental cast-steel tracks with rectangular pockets formed in them, into which mesh the teeth of a heavy rack which is carried on the horizontal tracks. The purpose of the rack is to prevent any slipping motion during the opening or closing of the span. The counter-weighting is so adjusted with reference to the center of gravity that the span will open or close by gravity through the first 40° of its travel, leaving the operating machinery to complete the closure or opening. Thus, if the locking mechanism is released when the span is closed, the latter will rise through 40° and then come to a rest. Similarly, if the locking devices are released when the span is in a raised position, as shown in our engeaving, the span will fall through 40°, leaving the other 40° of travel to be operated by the closure mechanism.

The opening and closing is accomplished by means of a trussed operating-strut, provided on its under side with a rack which is engaged by a cast-steel pinion driven by the 60 horse power electric motor above referred to. Two speeds are provided, the faster allowing the bridge to be opened in calm weather in thirty seconds, while the slow speed, which is thrown in during the prevalence of high winds, will close or open the bridge in ninety seconds.

SIGNOR MARCONI has arrived in New York. He comes on a short business trip.

An Automatic Coherer.

An automatic coherer has been devised by M. Tommasina, which will, no doubt, render great service in wireless telegraphy. The experimenter, who has been working for some time in this direction, described his method at a recent meeting of the Académie des Sciences, his idea being to devise a coherer in which the agglomeration of the particles ceases immediately after the action of the electric wave, without any outside action, even that of breaking the current. He commenced his experiments by using powdered carbon, which was placed between two carbon cylinders of 5 millimeters in diameter, passing by friction in a glass tube. After a few trials he obtained an automatic decohering action, but this was somewhat irregular, and he found that the inertia of the relay interfered with the action. When this was removed and simply a battery and telephone was contained in the circuit of the coherer, a much better result was obtained, but in some cases the carbon refused to return to the normal condition instantaneously, this requiring sometimes as much as several seconds.

The form of coherer which was finally arrived at seems to work very well, and the decohering action is instantaneous. It is small enough to be contained in an ordinary telephone receiver, and is made by cutting out of a strip of ebonite 2½ millimeters thick a rectangle 12 × 15 millimeters; this is pierced with a hole 2 millimeters in diameter, and a groove is filed in each face of the piece. A German-silver wire, silk-covered, is passed through the hole and along the grooves, and twisted together on the outside, forming a loop, and a second wire is similarly disposed opposite to this, the two wires being face to face in the opening, and the silk covering is here removed. The hole is closed on one side by a sheet of mica fastened to the block and the opening is filled with powdered carbon; a second plate covers this, forming a coherer whose electrodes are constituted by the two wires, these being about a millimeter apart. The cover of a telephone receiver is unscrewed, the circuit of the coil is cut and the coherer inserted, placing it so as not to touch the diaphragm.

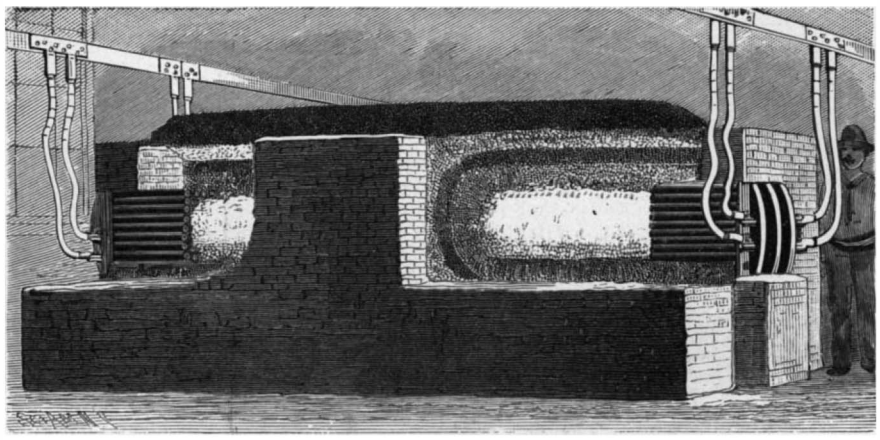
On trial, this arrangement works well with a single dry pile in the circuit of the telephone and coherer, and its sensitiveness is equal to that of a coherer made with metal filings. A shock is heard in the telephone upon the passage of each spark of the oscillator, no matter how rapidly these follow each other; the action is entirely automatic, suppressing the striking device necessary with the usual form of coherer, and the use of carbon gives it increased stability. The experimenter hopes to succeed in adapting the coherer directly to a Morse registering receiver, and considers that this will solve the problem of rapid transmission in aerial telegraphy.

IN Brooklyn, New York, a modified pile driver is used to break up the asphalt pavement of Bedford Avenue. This pavement was put down many years ago, and was in such bad condition that an entirely new pavement had to be substituted. The pile driver is mounted on a heavy cart which can be moved about easily. A hoisting engine raises the hammer, which weighs about 15 hundredweight and has a 14-inch chisel edge. The action of the hammer is to break up the pavement into square blocks, and water and gas pipes frequently suffer if they are near the surface. There is little question that this contrivance is a great time saver.

MANUFACTURE OF CARBORUNDUM AT NIAGARA FALLS.

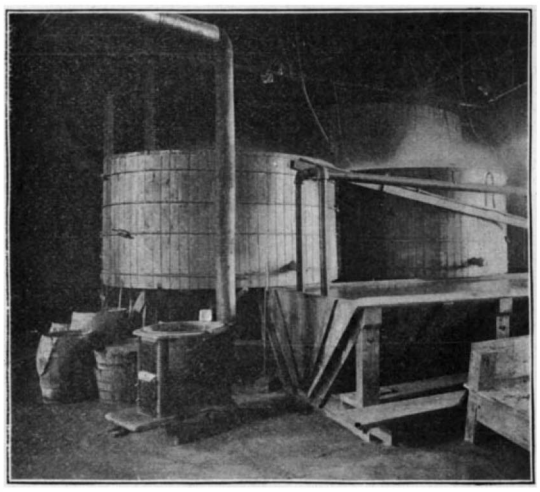
The method of making carborundum was discovered after careful research and a long series of experiments, in which the inventor, E. G. Acheson, found that carbon and silicon could be made to combine to form the remarkable abradant which during the last ten years has entered so largely into the industrial arts. The earliest experiments consisted in forming a mixture of carbon and clay and subjecting it to a high temperature produced by the electric current. An examination of the mass after it had cooled disclosed some minute crystals of a dark blue color, and of extreme hardness, and in a test of these particles it was found that their abrading action was very marked. Early in the investigation it was found that the silicon of the clay was the important factor in the formation of the crystals, and subsequent investigations led to the development of the process of manufacture which forms the subject of the present article.

As to the efficiency of carborundum compared with other abradants, it has been difficult to carry out exhaustive comparative tests; but it is stated by the manufacturers that it possesses eight times the efficiency of emery, weight for weight. That is to say, that one pound of carborundum will polish eight times as much surface as the same weight of emery, and will do it in about half the time. The diamond is the only material which exceeds it in hardness. Its specific gravity is 3·12.

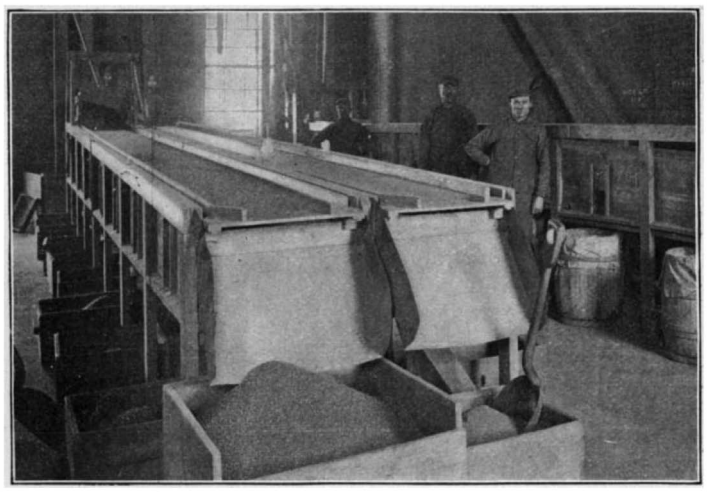


Part Sectional View of Carborundum Furnace.

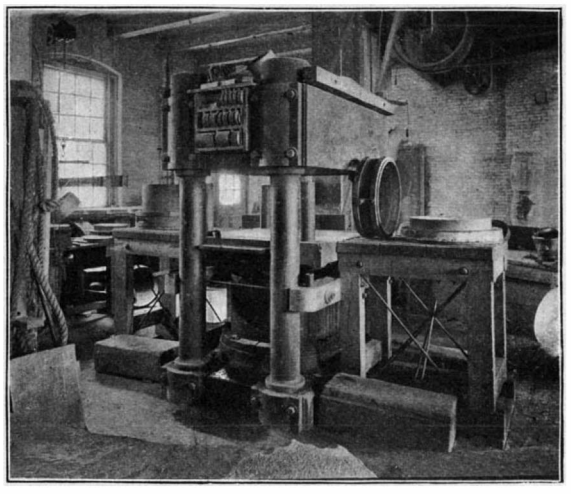
It is not fusible at the highest attainable heat, and it is insoluble in any of the ordinary solvents. It is composed of carbon and silicon in equal atomic proportions, and by weight thirty parts carbon to seventy parts silicon. Pure carbon is white in color, although in the commercial manufacture the crystals are produced in many shades and colors, the prevailing colors being green, black, and blue. Crude carborundum, as taken from the electric furnace, usually consists of large masses or aggregations of crystals. Grain carborundum is pro-



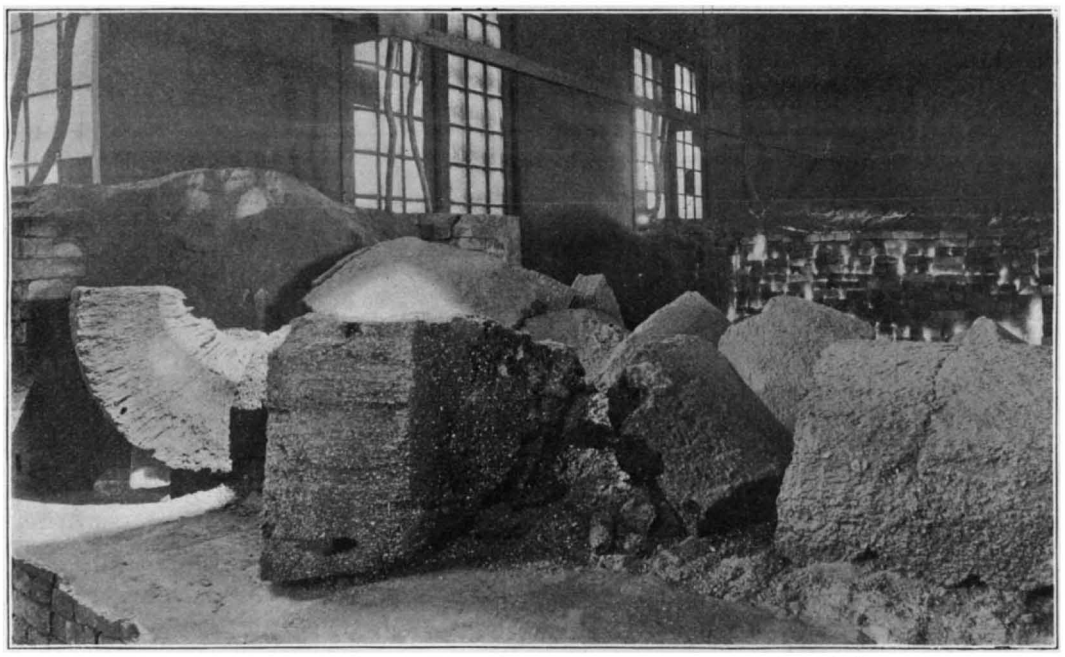
Sulphuric Acid and Settling Tanks.



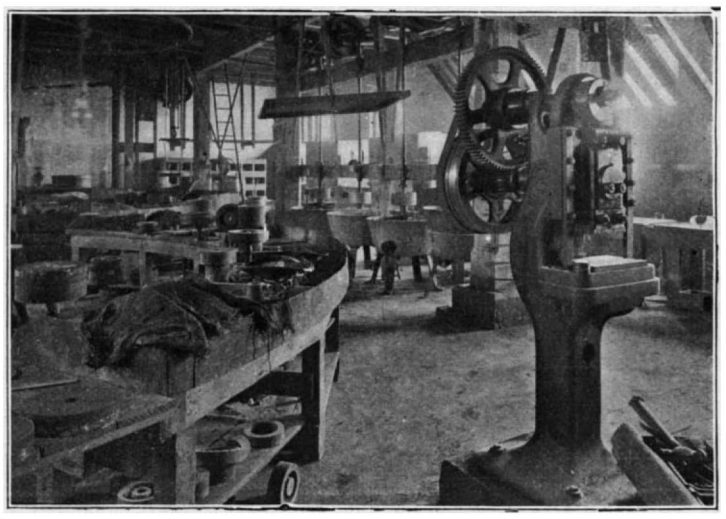
Shaking Screens on Which the Carborundum is Graded.



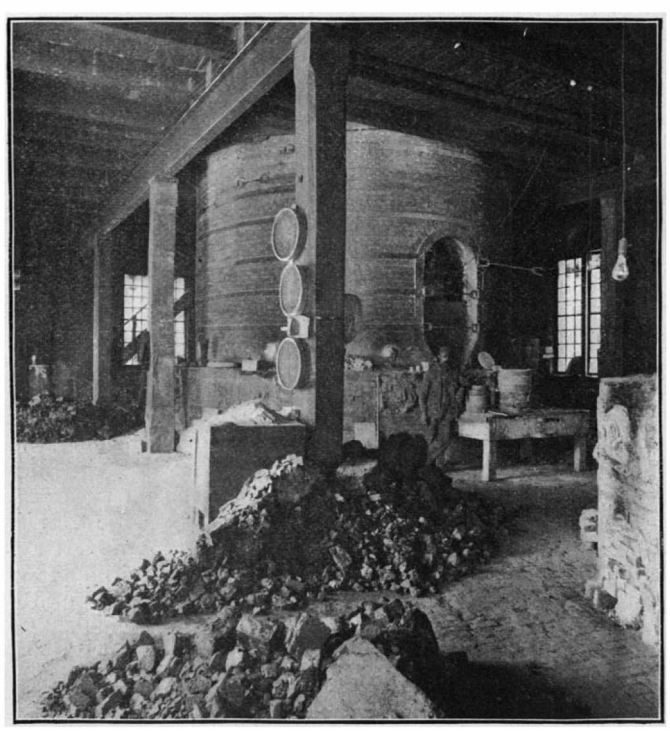
1,500-Ton Hydraulic Press for Forming the Large Wheels.



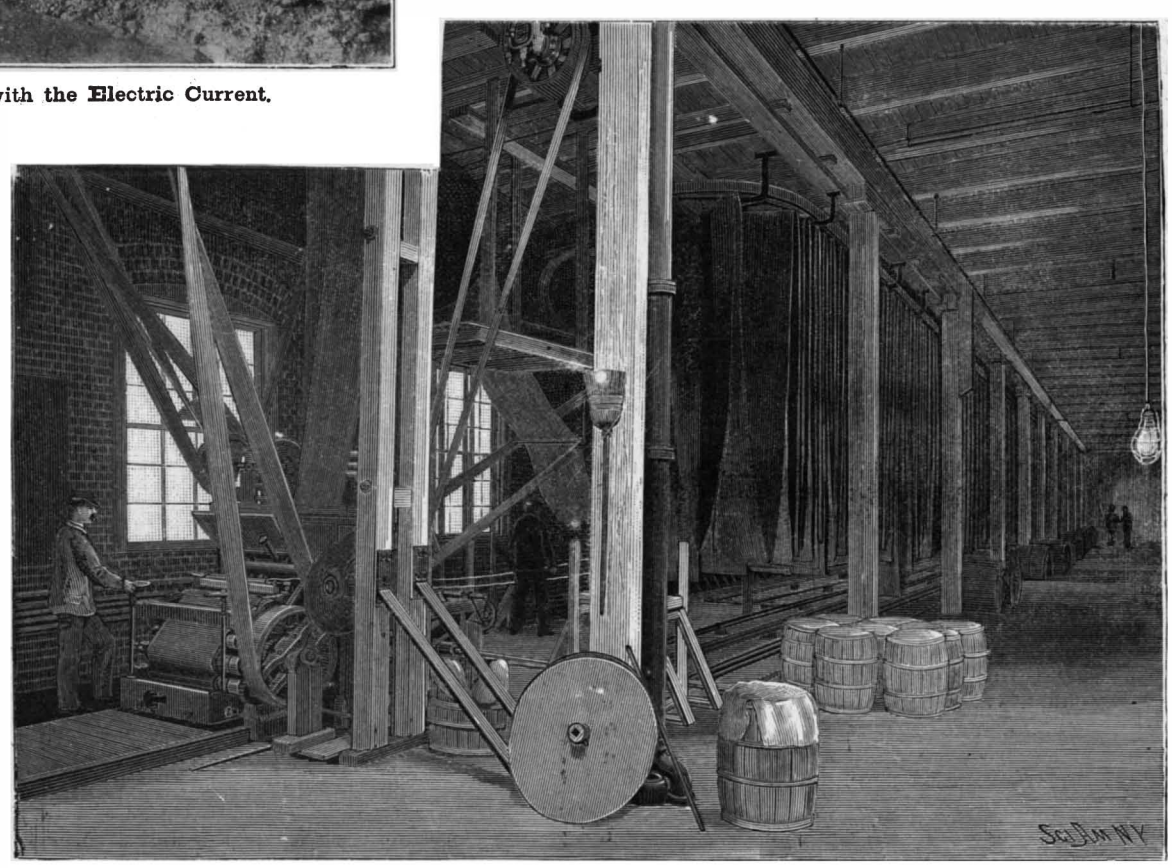
Contents of Furnace Broken up after Treatment with the Electric Current.



Mixing Ground Crystals with Bond and Moulding the Wheels.



Kiln in Which the Wheels are Baked.



Making Carborundum Paper.

MANUFACTURE OF CARBORUNDUM.

duced by crushing and grinding crude carborundum, treating it with acid, and separating it by sieves into grains of various sizes.

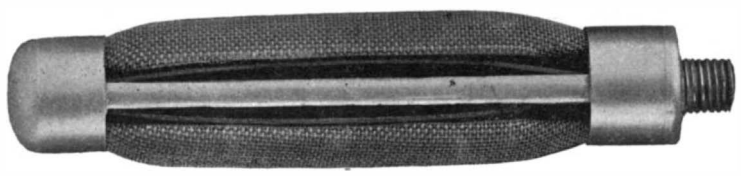
The crude materials for the manufacture of carborundum are sand, coke and sawdust. Part of the coke is reduced to kernels of a certain size to be used as the "core" of the electric furnace, while part of it is ground to a fine powder to be used in making the mixture or charge of the furnace. The mixture is made up of 60 per cent of gritty pure sand containing 99 per cent of silica, to 40 per cent of coke. A certain amount of coarse salt is added, and sawdust in sufficient quantity to make the mixture porous as soon as the sawdust shall have burnt out in the operation of the furnace. The furnaces are built of loose brick in the form of an oblong box, measuring 22 feet by 7 feet by 5½ feet. The ends, as shown in the engraving, are built up very solidly with a thickness of about 2 feet, while in the center of each end is a terminal which is built up of twenty-five carbons, measuring 4 inches square in section and 30 inches in length. The outer ends of the carbons are inclosed in a square iron frame, to which is screwed a plate bored with holes, through which are passed short lengths of ⅜-inch copper rods, one of which fits tightly in holes drilled in the ends of the carbon. Each end plate is provided with four laterally projecting copper bars ⅝ of an inch thick by 4 inches wide, to which the cables conveying the current are bolted. The side walls of the furnace are first built up to a height of about 4 feet, and it is then filled with the mixture of coke, sand, salt and sawdust until it is rather more than half full. A semicircular trench with a radius of 10½ inches, reaching from end to end of the furnace, is now hollowed out in the mixture, and in this trench is placed a core of the grains of coke, which measure, by the way, from ¼ to ⅜ of an inch in diameter, the bottom of the core being a little above the level of the bottom row of carbons. A new core requires about 1,100 pounds of coke, and after this amount has been placed in the trench, the top is rounded off so as to give the core a cylindrical shape. When it is finished we have extending from terminal to terminal, through the center of the furnace, a cylinder of coke 21 inches in diameter and 14 feet long. The brick walls are then carried up to their full height of about 5 feet, and the mixture is packed in around the core and heaped up to a height of about 8 feet above the floor of the furnace room.

From this point on the work of turning the mixture into carborundum is performed entirely by the electric current, which is supplied from the Niagara Falls Power Company, and has a pressure of 2,200 volts. This, of course, is too high for the purpose, and the current is first transformed at the carborundum works by a transformer of about 1,100 horse power which brings the current down from 2,200 to 185 volts. By means of a regulator it is possible to vary the pressure of the current as thus transformed between 250 and 100 volts. Current is conveyed to the furnace by two copper conductors having a sectional area of 8 square inches each, while heavy cables connect the main conductors with the plates on the terminals of the furnace. This arrangement is clearly shown in one of the accompanying engravings. For the first half hour no apparent change occurs in the furnace; but when the current has been on for three or four hours, the side walls and top of the furnace are enveloped by burning carbon monoxide gas. At the end of four or five hours the top of the furnace subsides, and fissures form, from which pour out the yellow vapors of sodium. At the end of thirty-six hours the current is cut off and the furnace, whose temperature is supposed to be between 6,000 degrees and 7,000 degrees, is allowed to cool. The side walls are taken down, and the outer mixture, which has not been changed by the fierce heat, is raked off, until the outer crust of amorphous carborundum is reached. This is broken away, exposing an inner crust of amorphous carborundum; and after this has been taken off, the crystalline carborundum is exposed.

The cross section of a carborundum furnace now presents a remarkable appearance. In the center is the core of coke, which has lost its crystalline appearance and is now a pure carbon, the impurities having been all driven off by the fierce heat engendered in the furnace. Around the core is a cylindrical shell 10 or 12 inches in thickness composed of beautifully colored carborundum crystals, the yield from a single furnace being about 4,000 pounds. Outside of this is a comparatively thin shell, 3 inches in thickness, which constitutes the inner crust of amorphous carborundum, and beyond this is an outer crust of amorphous carborundum, which latter ends abruptly in the unchanged mixture. The unit consists of several furnaces, but only one furnace is operated at a time, taking the whole 1,000 horse power of electric current for thirty-six hours.

The carborundum crystals are next taken to the crushing mills, after which the material is put into large lead-lined tanks, and treated for three days with diluted sulphuric acid to remove impurities. From the circular tanks it passes to a long trough where it is washed with water to remove the finely powdered carborundum, which is carried by the water down through the settling tanks. Here the fine powders are collected, and from these are made the so-called "flowers" and the hand-washed powders. After the water has been drained off from the sulphuric acid tanks above mentioned, the crystals are shoveled out, dried, and graded on the long, inclined, shaking screens, which are shown in one of our illustrations. There are twenty grades of crystals from No. 8 to No. 220, the numbers indicating the meshes to the linear inch of the screen through which the crystals have passed.

In the greater part of the carborundum goods put on the market the vitrified bond is used. The carborundum is mixed with a certain proportion of kaolin and feldspar, and the mixture is then placed in moulds and subjected to hydraulic pressure. The moulded wheels, disks, stones, etc., are taken from the press and placed on supports known as "bats," which are made of baked clay. The bats are placed in clay "saggars," which are built up in columns within the kiln until they reach its roof. Here they are baked for about six days, during which time the feldspar fuses and serves to bind the carborundum into a solid mass. When wheels are removed from the kiln they are too rough for service, and they have to be placed in lathes, trued up with rotating, chilled-steel disks, and the central hole bushed to the proper size.

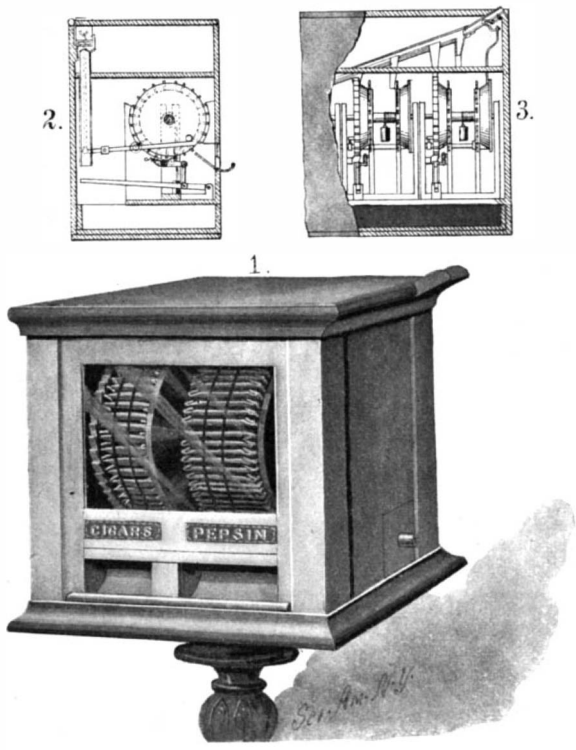


THE TOMLINSON GUN-CLEANER.

The wheels are tested to 50 per cent over their working speed. The operator who does this testing makes a sworn statement to this effect, a certificate of which is pasted on each wheel. The wheels range from tiny dental wheels $\frac{1}{16}$ of an inch thick and ⅛ of an inch in diameter up to wheels 6 inches in thickness and 36 inches in diameter; and just here it may be noted that to obtain the cutting material in a 36-inch wheel involves the expenditure of energy amounting to 1,250 horse power hours.

One of our illustrations shows the method of making carborundum paper. The paper, which is carried at the front end of the machine near the operator, is first printed on the reverse side with the maker's name and other data. From the printing roll it passes to a bath of liquid glue, and then beneath a V-shaped hopper, from the bottom of which a fine stream of powdered carborundum falls upon the glued surface. It is then looped up onto a series of racks where it is hung to dry. When the drying is complete, it is wound into rolls or cut up into sheets ready for the market.

The uses of carborundum are as numerous as the industries which call for the use of powerful abradants. Watchmakers have found that it may be used in place of diamond, as it performs equally good work at less cost. Mounted on cloth or paper it is used in finishing the soles of shoes. It is used in the plate glass industry and in the manufacture of pottery and porcelain, while in the heavier work of roll and car-wheel grinding it has proved that the greater cost of the material as compared with emery is more than offset by its superior abrading qualities.



A VENDING-MACHINE OF NOVEL CONSTRUCTION.

EFFICIENT SHOT-GUN CLEANER.

The accompanying illustration represents a simple and effective shot-gun cleaner made by the G. T. Tomlinson Company, Syracuse, N. Y.

The Tomlinson cleaner is composed essentially of a nickeled-brass frame carrying two nickeled-brass caps, one of which is soldered rigidly in place, and the other of which screws on a threaded stud. Between the caps, pads are held, which are pressed outwardly by flat springs. The pads are composed of wood covered with brass-wire gauze. So soft is the brass wire that the finest polish cannot be injured. The cleaner can be applied to any standard rod. It is so designed as to fit the entire length of the shot-gun barrel, notwithstanding the various chokes adopted by different makers. The cleaner will, therefore, remove all lead, rust, and foreign matter from breech to muzzle.

The bearing surface on the inside of the barrel is four square inches. Old pads can be readily renewed by unscrewing the end cap, removing the worn pads, inserting new ones, and replacing the cap.

THE English Patent Office has just issued its report for 1899, and it appears that there has been a falling off during the past twelve months, as there is a diminution of about 1,000 in the number of the year's complete specifications. The outbreak of the war occasioned the invention of several shields and cuirasses for soldiers; the abnormal heat during the summer resulted in many applications for patents for headgear for horses; and the passing of the "Shop Assistants' Seats Act," by which every employer must provide his assistants with seats during their work, resulted in the granting of patents for over fifty various kinds of seats. The largest number of applications in one day was 127, and the smallest 50. Women were responsible for 574 specifications, 149 of which were in connection with articles of dress, and 42 related to cycling. The general diminution is attributed to the great decline of invention in connection with the cycling industry.

IMPROVED VENDING-MACHINE.

Letters patent have been granted to James E. Martin, of Braddock, N. D., for an invention which provides a coin-controlled machine for dispensing cigars and other articles. The machine is so constructed that articles of various prices can be sold, the coins of different value finding their way to compartments especially designed to receive them.

The cigars and other articles to be sold are carried on revolving drums comprising each an inner circular section provided with pins, an intermediate conical section, and an outer circular section provided with teeth. The drums are driven by weights. A trip-lever, as shown in Fig. 2, extends below the coin-conductor of each drum compartment, beneath the toothed portion of the drum, and actuates a pawl which controls the movement of the drum. In order that the cigars may not drop out of the drum, a guard is provided which partially surrounds the drum.

The coins which drop on the trip-levers are conducted by a chute of novel construction. The chute is provided with a series of openings of varying size to receive coins of different denominations (Fig. 3). The upper openings receive the smaller coins and the lower openings those of larger size. Conductors extend downwardly from these openings to the several trip-levers which actuate the various drums. Before each opening a somewhat smaller orifice is located, which is designed to receive a coin of smaller size, so that the mechanism cannot be fraudulently actuated.

When a drum has been emptied, a pin on the toothed face engages a lever (Fig. 2), which, through the medium of a rearwardly-extending arm, actuates a rod provided at its upper end with a fork which operates a non-magnetic retarding device in the coin-chute. The retarding device is hooked, to engage washers which may be inserted in the chute. A magnet is likewise provided, which will retain the iron disks and plugged coins that pass the retarding device. When a coin slides down the chute, it completes an electric circuit, which rings a bell, but the time of its travel is so short that the circuit is completed for an instant only.

A good coin dropped in the chute finds its proper opening, falls upon the proper trip-lever, releases the pawl and causes the corresponding drums to be driven by the weight. When one-half of the drum is empty, the other half will rotate the shaft by gravity, rendering the weight for the time being unnecessary. The drum is allowed to turn by the pawl only for a certain interval. The cigars are discharged on the usual tray. When a drum is entirely empty, the pin on the outer, toothed face engages its lever, so as to operate the retarding device, complete the electric circuit and ring a bell. Washers, pieces of metal and steel disks which cannot pass down the chute likewise complete the circuit and sound the alarm. Perhaps the most attractive feature of the invention is the precaution which has been taken to prevent the operation of the mechanism by none but good coins.

A CURIOUS HISTORIC WEAPON.

BY ROBERT WILSON, D.D.

In the year of grace 1691, the Lords Proprietors of Carolina conferred upon Thomas Smith, Esq., the patent of Provincial Nobility, which made him hereditary Landgrave of Carolina, and proprietor of four baronies, consisting each of 12,000 acres of virgin land. His eldest son, heir to his father's title and most of his acres, was the owner of the curious and interesting historic weapon which is the subject of this sketch. In view of the fact that this gentleman possessed an estate of some 60,000 acres, and a family of no less than twenty sons and daughters, it is little wonder that his will should be one of the most voluminous of the ancient documents that are of record in the probate archives of Charles Town. The following is the only item in the will which concerns this paper: "I give and bequeath unto my son Henry Smith my large silver Tankard and my double barrill Pistols, and such a gun as he shall chuse out of my Gunns, and my silver hilted Sword and two silver Spoons."

One of these pistols is still preserved by a descendant, and is the remarkable weapon here figured, its special interest consisting in the fact that it is a *revolver*, and one of the few existing examples of the application of the principle to fire-arms operated by flint and steel. Although it is well known that revolving weapons were invented certainly as early as the middle of the fifteenth century, there is no evidence of such fire-arms' having ever been in general use.

The revolver, as will be seen from the cut, is a handsome, well-made and not unwieldly weapon, some sixteen inches long, smooth-bored, and carrying a half-ounce ball. A reference to the cuts will readily explain its working. The barrels are placed vertically, being bound firmly together by two grooves of mahogany presenting a V-shaped section, giving the possible maximum of lightness, and strongly clamped at the base by a brass-faced steel breech-plate, fitting closely to a similar plate on the stock. Between the barrels on one side the wood is grooved and fitted with a spring-clamped steel scabbard for holding the ram-rod secure. Each barrel is provided with the ordinary priming-pan and spring steel-faced cover for the impact of the flint. These springs are strong enough to-day to secure the priming from falling out while the barrel is reversed, and indeed, after nearly two centuries of disuse, the pistol is in perfect working order, and might be loaded and fired as readily as when it left the maker's hands, the original flint being still in place and striking its shower of sparks at the touch of the trigger. There are no sights, as these would be unnecessary at the close-quarter range for which the pistol was intended.

The stock is of mahogany, simply carved, but richly mounted with silver filigree work, the heavy silver cap on the butt bearing the landgrave's crest, a greyhound sejant gu. collared and chained or. The lock is of the best workmanship, the hammer-spring still strong and reliable. The revolving mechanism is of the simplest character. A short cylinder or pin projects from the center of the breech-plate, passing through the corresponding plate on the front of the stock, the two plates fitting with perfect accuracy. The upper barrel having been fired by a light touch of the trigger, the weapon is again cocked, the forefinger pressed on the movable spur on the outside of the trigger-guard, releasing a spring clamp, and the barrels, grasped by the left hand, are quickly revolved, bringing the under pan into position before the hammer, where it snaps firmly into place. All this may be done in a few seconds, the whole device being a wonderful improvement on the awkward broad-breeched arrangement of the ordinary flint-locked horizontal double-barrel. One cut represents the pistol ready for use, and the other shows the barrels half revolved. The maker's name, "E. Tilley," may still be deciphered on the lock-plate, but there is no date and no hall-mark on the silver work. The weapon, however, is certainly one hundred and seventy-five years old and more, probably two hundred, for the colonial nobleman who owned it had need of its protection before the eighteenth century began. It may well have been a part of his equipment as a captain in the Provincial militia in 1696, for gentlemen officers in those days provided their own mounts, arms and uniforms, and enough is known of the personal characteristics of "the little Englishman," as he was familiarly called, to make it certain that in his case all these would be of the best.

These pistols have been a cherished heirloom in the family—or rather in one of its innumerable branches—for more than a hundred and fifty years, and hung together on the walls of Yeamans Hall until the close

View Showing Barrels Half Revolved.

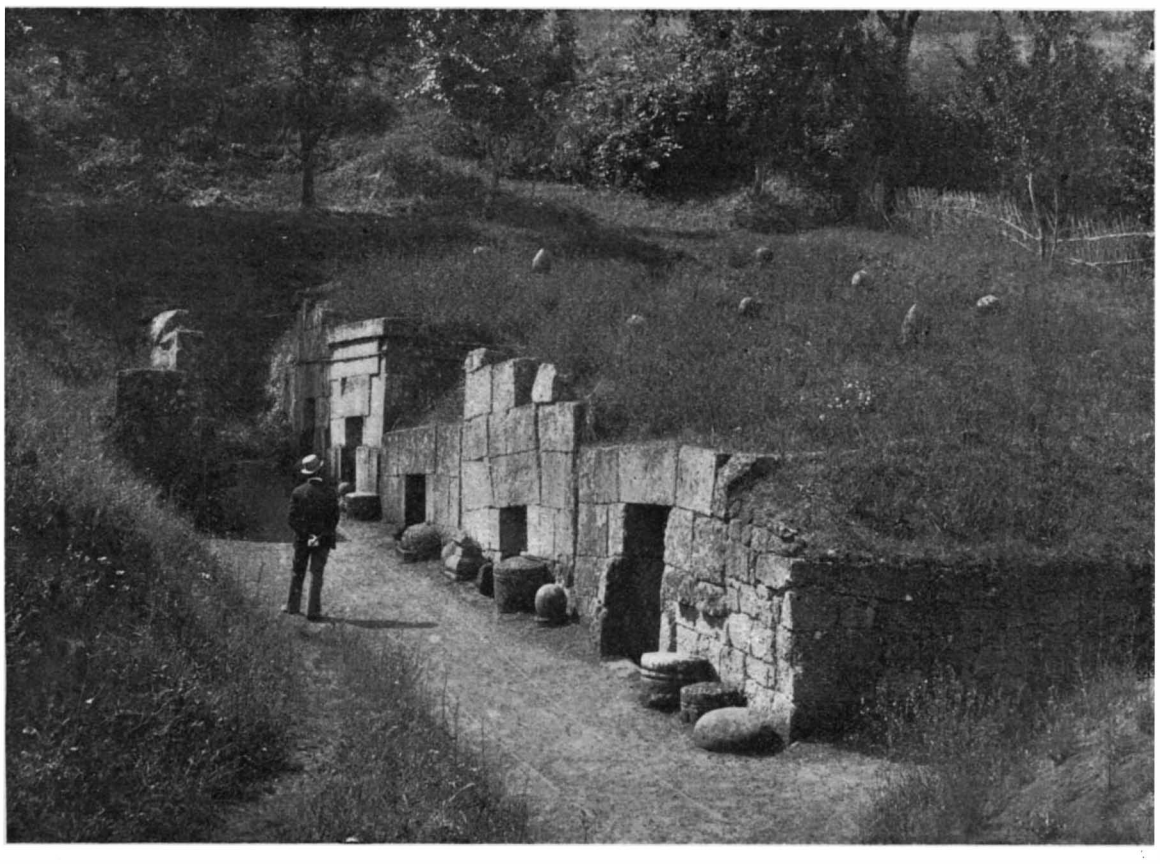
Barrels in the Firing Position.

COLONIAL FLINT-AND-STEEL REVOLVER. AGE, 175 TO 200 YEARS.

of the war between the States, when they formed part of the loot carried off by a guerrilla band. The weapon shown in our engravings was recovered, but the other has never been heard of since that day.

ETRUSCAN TOMBS AT ORVIETO.

The Etruscan remains in Italy vie in interest with the later Roman remains. In many cases they are more interesting, for they are hidden away in the small cities and towns, and are not seen by the tourist unless special journeys are made to obtain a comprehensive view of the subject. Orvieto with its superb cathedral lies on the northeast of, and on the extreme



ETRUSCAN TOMBS AT ORVIETO, ITALY.

verge of the great Etruscan plain. The situation is one of the most commanding of all the hill towns of Italy, and it is little wonder that the old Etruscans and the mediæval Italians had the same views about its being an ideal position for the building of a town and its fortress. The antiquity of Orvieto is very great and its history can be traced back several hundred years before Christ. Unlike most Etruscan sites, Orvieto does not retain a vestige of its ancient wall, which forms so marked a feature of all important Etruscan towns, the great blocks of masonry being put together without mortar or cement of any kind. That Orvieto was Etruscan was proved only within this century by the discovery of the tombs in the immediate neighborhood.

In 1874 the most important find of all was made; this was the Necropolis at the foot of the cliffs beneath the city to the north. This is probably the most attractive collection of tombs to be found anywhere in Etruria. They are not hollowed out in the rocks as is the case with most Etruscan burial sites, but they are constructed of massive masonry and arranged side by side and back by back, exactly like houses in a town, forming insulæ, or blocks of tombs instead of residences; each tomb having its doorway closed by a slab of stone and the name of its occupant engraved in large Etruscan characters on its lintel. These blocks of tombs are separated by streets crossing each other at right angles, so we have here truly a "city of the dead." According to Dennis, the masonry is of local red tufa, cut in large rectangular masses, and always laid without cement. The tombs are 11 or 12 feet deep, 6 or 7 feet wide and 9 feet high, constructed of very neat masonry. For the last three courses the walls are upright, but above that the courses project on either side and gradually converge until they meet in the center of a flat course forming a primitive sort of vault. The faces of the blocks within the tomb are not hewn to a curve to resemble a Gothic arch, as in the Regulini-Galassi tomb at Cervetri, but the angles of the projecting blocks are simply beveled off. These tombs are considered by the archæologists to date from before the invention of the arch of Etruria and are therefore, in all probability, earlier than the foundation of Rome. While some of them are quite empty, others contain a rude bench formed of slabs on which the corpse was laid. Each sepulcher can be removed without disturbing its neighbors. Each terminates above in a high wall of slabs, which face it in, and inclose the roof. Across this inclosure stretches the masonry which roofs in the tomb, in a double flight of stone steps, meeting in the middle in a narrow ridge which tops the whole. On this ridge or by its side stood a stela or cippus of stone, shaped in general like a pointed cone or the finial of a cupola. Some of them bore inscriptions, and it was observed that when this was the case, the epitaph over the doorway was always wanting. According to Dennis, whose extensive researches upon Etruria are of the greatest importance, the doors of the tombs are tall, narrow and without architectural decoration, not having even the Egyptian or Doric form so common in other Etruscan cemeteries. The inscriptions are very peculiar, not so much in the form of the characters as in the epitaphs themselves, which are written without the usual division into words. They all have the peculiarity of commencing with the word "mi." Thus in the street shown in our engraving, which has been sadly overgrown since its discovery, there are four epitaphs: "Mimamarkesteethelies," "Milauchusieslatinies," "Mimamarkestriasnas," "Milarthiasrupinas."

The Current Supplement.

The current SUPPLEMENT, No. 1276, has many articles of unusual interest. "The Power Generating Plant at the Paris Exposition" is elaborately illustrated. "An Outline of the Development of American Locomotives" is illustrated by five engravings, made from large drawings which were made for the Paris Exposition. "Recent Developments in Nernst Lamps" describes the commercial forms of lamps which have been used. "On Krypton" is a valuable chemical article. "The Tapir" forms the subject of a full-page engraving. "Means of Defense in Animals, II.," by Philip Calvert, Ph.D., of the University of Pennsylvania, appears in this issue. "The Protection of the Young" is dealt with in this section. The article is of great interest and importance. "The Wind Cave of South Dakota" is by E. O. Hovey. "The Political Organization of the Filipinos" is by R. L. Packard.

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RECENTLY PATENTED INVENTIONS.

Electrical Apparatus.

INSULATOR.—EMILIO ZERTUCHE, Puebla, Mexico. The insulator consists of a body having a Z-shaped passage, the end portions of which extend in opposite side surfaces; while the central or diagonal member extends through one of the end surfaces of the insulator. The wire is held securely in position by the grooves, without being bent. After having been placed in position in the insulator, the wire can be readily stretched.

SIGNALING SYSTEM.—LESTER C. SMITH, Torrington, Conn. The object of the invention is to provide a telephone signaling system for factories, shops, and the like, which is arranged to enable a person at one station to call up another at any other station. Each local station contains a receiver, a transmitter, a call-bell, and a shunt bridging the terminals of the call-bell. A series-line contains batteries and includes the call-bells. One of two parallel lines is connected with one end of the series-line; and the second is connected with the other end of the line. Switch-levers in the series-line are adapted to hold the receivers and to break the circuit in the series-line in order to separate the parallel lines with respect to the call-bells.

Engineering Improvements.

STEAM-HEATING APPARATUS. — ALBERT P. BROOMELL, York, Penn. This invention provides a steam-heating system by which it is possible to regulate the amount of steam admitted to each radiator and to heat each radiator partially or entirely. All the radiators are open to the atmosphere, the steam being circulated without pressure. No air-valves are used. The production of steam in excess of the demand controls the damper of the boiler-furnace and automatically operates relief devices, whereby the water of condensation will be returned to the boiler, and whereby the shutting-off of steam from the radiators will automatically open a vent from the radiators to the atmosphere.

Bicycle-Appliances.

DRIVING MECHANISM FOR BICYCLES OR OTHER VEHICLES.—JOHN C. BUSCHE, Wilkinsburg, Penn. The driving mechanism is chainless. The usual rotary movement of the pedals is preserved, although the parts operating upon the driven wheel are reciprocating levers actuating a driving-wheel. The driving-wheel is a toothed rim engaging a pinion on the driven wheel and receiving a peculiar motion. The invention is applicable to steam-vehicles. It often happens that a driving-shaft breaks at the crank-portion, a difficulty overcome by the inventor by the use of a straight shaft. In an ordinary reciprocating engine, two strokes of the piston produce one revolution of the driving-shaft; here they produce from three or more.

Mechanical Devices.

BORING IMPLEMENT. — WILLIAM T. MAXWELL and GEORGE J. SPAHN, 943 W. Lombard Street, Baltimore, Md. The tool is designed for use in boring through joists or in corners or angles where the ordinary brace and bit cannot be employed. A rotatable bit-shaft and a rotatable and longitudinally-slidable brace-shaft are connected by two meshing miter-gears. One of the gears has teeth arranged in opposite directions; and the other has two sets of teeth inclined in the same direction, but at a lesser angle. The bearing for the brace-shaft is pivoted and adapted to swing, and can be clamped in either of the two angles to which it can be adjusted.

STROKE-REGULATOR FOR WINDMILLS. — ERNEST R. NICHOLS, Manhattan, Kans. The invention has for its object to regulate the action of a wind-wheel by varying the length of stroke according to the velocity of the wind. To effect this result, the inventor employs a lever whose stroke is lengthened or shortened automatically, as the force of the wind is greater or less. The lever is in the form of an isosceles triangle, one side of which is variable in length.

REFINING-ENGINE. — CHARLES E. TORRANCE, Northampton, Mass. The invention relates to paper-making machinery and provides a refining-engine arranged to permit a quick adjustment of the shell and revolving plug without disturbing the position of the plug and the driving-gear, so that the latter always remains in true alinement with the overhead countershaft-pulley. The plug and shell can be removed whenever necessary, without disturbing the driving-gear.

CHANGE-RETARDING DEVICE FOR WEFT-REPLENISHING LOOMS. — WILLIAM N. KIMBALL, Somersworth, N. H. In Northrop looms, as heretofore constructed, the filling fork fails to tip the moment the filling breaks, so that the bobbin-battery is actuated and a new bobbin immediately placed in position in the shuttle. A mispick is, hence, invariably made, since the harness is then not in proper position. With the inventor's improvement, the calling for a new bobbin is delayed to allow the harness to return to the position it had at the time of the breaking of the filling, so that when the new bobbin is called for, the harness is in the proper position. Consequently a mispick is prevented.

RULING-MACHINE.—GEORGE W. KAUSER, Manhattan, New York city. This machine is designed to rule upon plain paper either at regular distances apart or at uniformly increasing or decreasing distances. The device works on the principle of the parallel ruler and is especially adapted for ruling the lines of music scores or plays. The device is compact, as well as simple in construction.

Railway-Appliances.

SPIKE.—JAMES HENNIGAN, Inkerman, Penn. According to this improvement, the spike is so constructed that it will be prevented from being pressed back from a moving rail. And the invention consists in so pointing the spike that it will start easily in a tie and cut better than the ordinary spike. The point is so shaped that, as the spike is driven, it will tend to force the head of the spike in the direction of the flange of the rail.

COMBINATION BOX AND STOCK CAR.—CHARLES H. RUSSELL, Corsicana, Tex. The car has sides with fixed spaced slats, and a slat-frame movable up and down on the side at the slats to close the space between the fixed slats. Posts are attached to the frame and have vertical and transverse motion in guides. The car can by these means be readily transformed to carry either box-freight or live-stock.

Miscellaneous Inventions.

PICTURE-CABINET.—LAFAYETTE J. SANBORN, Davenport, Wash. The inventor has devised a dust-proof cabinet for photographs and other pictures, which consists of an outer casing containing a picture-carrying frame. By operating a pair of angle-levers through the medium of a push-rod, the pictures are successively thrust upwardly so that they can be readily removed. The remaining pictures are pressed forward into position to be acted upon by the angle-levers, by a spring carried in one of the side-walls of the frame.

THILL-COUPLING. — RICHARD ECCLES, Auburn, N. Y. The coupling has a thill-iron with a slotted eye, rearwardly from which a projection extends. An axle-clip carries a pivot-pin for the eye; and a link engages the projection. A hand-lever is connected with the link, and is fulcrumed on a spring forming part of the tie-bar of the axle-clip. The device is arranged to prevent rattling, to permit removing the shafts, and to assist in supporting them when in use, and to relieve the animal of the undue strain of the weight of the shafts.

TAPE-MEASURE.—JOHN G. EDDY, Brooklyn, New York city. The measure has the bearings of the guide-rollers mounted in the rim of a tape-line case, and is constructed so that the bearings are integral with and on the general surface plane of the rim. Hence, they can be formed during the process of making the rim, thus reducing the cost of manufacture. The bearings are formed so that there are no projections at the sides of the case, in order to avoid injury to the hand or pocket.

FIRE-ESCAPE.—WILLIAM A. SHAW, Orange, N. J. This apparatus has a supporting-arm for pivotal attachment to a frame. Brackets are mounted on the arm and adapted to be held in a horizontal position, whereby to support the brackets outside of the frame, or for their withdrawal. Pulleys mounted on the brackets have a supporting cable passed over them. The escape is readily placed upon any building and folded up out of way when not in use. A person can descend without assistance through its use, and can be guided in his descent by one below or one stationed near the opening at which its support is located.

OVERHEAD-TRACK SUPPORT.—JAMES W. BARNEY, Kansas City, Mo. This mechanism furnishes means for removably supporting an overhead-track from the roof of a shed or other building. With the supporting structure is connected a track, which can be raised and lowered by a vertically adjustable suspension device. Side-braces are supported from the device and are fitted to contact at their free outer ends with the supporting structure. The invention is particularly adapted to supporting the trackways of brick-conveyers in kilns, for which conveyers a patent is about to be granted to the inventor.

DUMPING-CART.—JOSEPH F. BLAISDELL, Brooklyn, New York city. The wagon-body is mounted to rock on a support which carries a bracket. A toothed segment is pivoted to the wagon-body and is guided on the bracket; and a second segment is mounted on the bracket and meshed with the first segment. An hydraulic cylinder is held by and located beneath the wagon-bed. A plunger, working in the cylinder, extends upwardly above the bed, and enables the cart to be easily and conveniently elevated and tilted to dump the box of its contents in any desired place.

FAN ATTACHMENT FOR UMBRELLAS OR PARASOLS. — OTTO BESELER, Calaveras, Tex. A sleeve or tube is carried by the runner; and on the runner a rotary fan is mounted which is driven by gearing leading to the umbrella-handle. Only a single finger is used to actuate the device.

FARM-GATE.—ADAM B. LONG, Amish, Iowa. The object of the invention is to provide a simple and cheaply-manufactured gate, which can be opened and closed from a wagon. The gate is provided with an arm extending laterally and rearwardly from its hinged end, beyond its pivot-post. A pull-rope is attached to the rear end of the arm. And a catch upon the pivot-post is adapted to engage the arm to hold the gate when opened.

ADJUSTABLE POLE-SOCKET. — FRANK PERRY, assignor to the J. Kroder and H. Reubel Company, 268 Canal Street, Manhattan, New York city. This adjustable pole-socket consists of an attaching member screwed to the window-casing and a pole member, the two members being held together by tongues working in slots. The two members can be readily locked and unlocked. As each is formed of a single piece of metal struck up by suitable tools, it is evident that the socket can be very cheaply constructed.

CURTAIN-POLE RING.—FRANK PERRY, assignor to the J. Kroder and H. Reubel Company, 268 Canal Street, Manhattan, New York city. This invention provides a very simple, strong, curtain-pole ring which has an eye completely covering and uniting the split ends of the ring without brazing. The eye cannot become detached from the ring; nor is the ring liable to open up, as so frequently happens with the ordinary rings.

COMPOSITION OF MATTER FOR FURNACE-LININGS AND OTHER PURPOSES.—RUDOLF KECK, Denver, Colo. In the production of lining bricks, burnt magnesian minerals are used which are mixed with a small percentage of binder, such as tar, clay, or ferruginous loam, etc., and burned at a very high heat. It is, however, impossible to produce a thorough mixture, for which reason the bricks, if not immediately used, disintegrate. To overcome the difficulty, the inventor employs a flux or binder which can be used in large proportions without disintegration. For this purpose he finds the shale constantly occurring in the Jura-Trias along the eastern foot-hills of the Rocky Mountains admirably adapted. The bricks made by this method can be used for filtering purposes and lining inside-walls of buildings, since they are bad conductors of heat and require no laths in calcimining.

BISCUIT-ROLLER.—CAROLINE P. MORRISON, Chattanooga, Tenn. This is a simple and effective machine in which dough is thoroughly ground and beaten by causing it to be forced by a roller against a convex breast-plate and broken, thus producing the consistency and texture in the dough requisite in the making of beaten biscuit. Dough treated by this machine becomes flaky and requires no baking-powder, soda, or the fermenting materials usually employed.

HYPODERMIC SYRINGE.—ALBERT S. J. STOVALL, Elberton, Ga. The invention provides a new and improved hypodermic syringe, which is simply and durably constructed, is not liable to get out of order, is readily manipulated, and is so graduated as to insure the administering of an accurate predetermined dose. The syringe is composed of few parts, which can be quickly separated to permit its thorough sterilization to render and keep it perfectly aseptic.

WHEEL.—WILLIAM F. MOSS, Fitzpatrick, Ala. This wheel can be used for various purposes, but more particularly for power-transmitting pulleys. To a certain extent it is resilient or compressible. It is also designed for use as a friction or belt-pulley in communicating power to various machines where a rigid pulley does not work satisfactorily, i. e., in places where the variation in the amount of power needed is liable to fluctuate between wide limits. The spokes are not rigidly secured to the rim, but are connected therewith by yielding springs, so that the belt cannot be thrown off.

BOWLING-ALLEY.—HENRY J. HECKENBACH, Belvidere, Ill. The bowling-alley comprises a table, a bed-plate upon which the pins are set up, and a ball-runway having an upper section provided with a lateral deviation and inclined downwardly from the pin-receiving end of the bed plate toward the other end, and a lower section inclined in the opposite direction with a discharge end facing the pins. A chute connects the upper and the lower sections of the run-way. It is a portable or parlor alley, and provides a game apparatus simple and durable wherein the number of pins knocked down is almost entirely a matter of chance.

FLY-NET.—PHILIP S. MINTON, Manhattan, New York city. This fly-net for horses is so constructed that it may be adapted to large or small animals, and attached to various portions of a harness without discommoding the animal or interfering with its movements. The net extends to the collar or the hames, a breast-strap being used for holding the forward portion of the net in position.

INDEX. — HENRY AUGUST HAUSINGER, Galveston, Tex. This index is made in two sections having a series of parallel rows with a reference-mark for each row, the reference-marks of one section being the same as some of those of the other section, but with the addition of a letter thereto at the end. A series of columns cross all the rows of both sections and contain letters in alphabetical succession and numbers corresponding with the paging of a ledger or other book. The invention relates to indices, especially to those adapted for use with ledgers and business books. It is simple and compact, allowing the available space to be utilized as perfectly as possible.

IRONING-BOARD.—ABRAHAM LEWIS, Chicago, Ill., and JACOB A. LEWIS, Manhattan, New York city. This invention provides means whereby the ironing-board may be quickly and conveniently applied to any support and adjusted as desired. Legs are employed which, when in a closed position, can be fitted snugly to the board, and when in supporting position, adjusted at any needed point between the outer end of the board and its central portion. The legs can be so attached to the board that they can be readily carried to either end of the board, so that skirts and like garments can be quickly adjusted and handled. Furthermore, the legs can be locked in a folded position, holding the board in a horizontal plane when the legs are on an uneven surface.

CURTAIN-FIXTURE.—HERBERT E. KEELER, Manhattan, New York city. In this device the curtain is held against the pull of the spring in the shade-roller by the frictional contact of a flexible guide with the head of the tube in the lower edge of the curtain. As this guide has a uniform tension its whole length, the contact of the guide with the heads is uniform to the free end. Thus the curtain can be readily raised or lowered by taking hold of the tube and moving the shade up or down. The fixture is intended for use in railroad, passenger, and street cars and other vehicles or places.

FIRE-ESCAPE.—FRANCIS J. HUGH, Manhattan, New York city. By means of this apparatus persons can descend safely from a building at an even rate of speed. The pressure with which friction-blocks are forced in contact with a belt varies according to the weight of those descending on the cable, making the device adapted for use by all. The fire-escape has a governor comprising a fixed brake-band, friction-blocks for engagement with the brake-band, actuating-blocks and a revoluble star-wheel engaging the actuating-blocks, to force them outward against the friction-blocks and move the latter in frictional contact with the brake-band, each of the actuating-blocks simultaneously engaging the ends of the two adjacent friction-blocks.

SURGICAL APPLIANCE.—DR. ROBERT W. BARTON, Marion, Ark. The inventor has produced a surgical splint which, without the use of weights, properly holds a fractured limb extended. A suitable opening is provided for the drainage and dressing of wounds. The appliance cannot be tampered with by the patient; for the operating-rod can be turned only by the surgeon or the nurse after it has been locked. The device consists of juxtaposed and separated pads arranged for attachment to limbs by bandages. Brackets are secured to the pads and are operated by rods. Locking-screws hold the rod in place.

SPIRIT-LEVEL. — LOUIS DESMARAIS, Manhattan, New York city. A tube, arranged to fit in the opening through the body portion of this instrument, is formed with a central sight opening and interrupted openings in its side walls, which completely surround the sight opening. A bulb-tube is inserted in the openings in the side walls; and cement fills up the side wall openings. The bulb-tube is placed lengthwise of the body portion when used as a spirit-level, and transversely when used as a plumb-rule.

SAUCE-BOTTLE.—JOHN M. CHAPMAN, Morristown, N. J. This bottle holds a sauce or other liquid condiment, so that the stopper will permit the contents, which usually tend to lodge at its mouth, to drain or otherwise find their way to the body while the cover or stopper is in place, thus avoiding the unclean and unsightly accumulation of material often seen at the neck and aperture. In the cover a chamber is provided to receive the handle of a spoon, when the cover is on the bottle.

STRAINER. — SYLVANUS ROBERTS, Chester, N. Y. The device is a strainer which receives dirt or other foreign matter contained in milk when poured into the strainer. The dirt is therefore prevented from entering the can with the milk. The strainer consists of a funnel-like body with sieve-covered openings in its lower part, a cup removably attached to the lower end of the body and provided with sieve-covered outlets, and a float-valve in the cup engaged in a valve-seat at the outlet of the body portion. The outlets of the cup are of less discharging capacity than the other outlets, so that the flow will be quicker through the cup outlets than through the body outlets, whereby the valve will be floated until the milk has been strained. The strainer can also be used for emulsions and similar liquids.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

ELECTROMETALLURGIE UND GALVANOTECHNIK. Ein Hand- und Nachschlagebuch fuer die Gewinnung und Bearbeitung von Metallen auf elektrischem Wege. Von Dr. Franz Peters. In Four Volumes. 8vo. 282 illustrations. Vienna: A. Hartleben. 1900. Price, paper, $4.

The four volumes which lie before us are essentially a digest of electro-metallurgical literature. They describe almost every process of obtaining and treating metals electrically which has been discussed in technical books and periodical literature. The first volume treats of antimony, tin, bismuth, beryllium, aluminium, magnesium; the second of copper; the third of the noble metals; and the fourth of zinc, lead, nickel, and cobalt. A most excellent index and an admirable bibliography are included in the fourth volume.

ESSAI SUR LA CONSTITUTION DE LA TÊTE DE L'INSECTE. Par Charles Janet. President de la Société Zoölogique de France. Paris: Georges Carré et C. Naud. 1899.

M. Janet's work in the morphology of insects deserves the consideration of every American naturalist. The originality of his methods, the evident care which he devotes to his subject, and the almost German exhaustiveness which apparently characterizes his writings should find favor for his study of the head of insects, with the few Americans who are at all interested in zoological morphology.

THE STUDY OF ELEMENTARY ELECTRICITY AND MAGNETISM BY EXPERIMENT. Containing 200 Experiments Performed with Simple Homemade Apparatus. By Thomas M. St. John. New York: Published by the author, 407 West 51st Street. 16mo. Pp. 220.

The book is designed as a textbook for amateurs and students, and the experiments which are illustrated and described are very simple, and the apparatus can be constructed by any one. There is considerable field for a book of the kind. It is fully illustrated by engravings and diagrams.

ANNUAL REPORT OF THE COLUMBUS ARCHITECTURAL SOCIETY FOR 1899. Edited by Homer C. Price, Secretary. Columbus, Ohio.

THE NEW ELEMENTS OF HAND RAILING. Second Revised Edition. By Robert Riddell, Ph.D. J. J. McVey, publisher. 1900. Quarto. Pp. 126, 41 plates. Price $5.

Hand railing is a difficult subject to most carpenters and many professional stair-builders, but with the aid of the present volume, all the most difficult problems in hand railing can be solved with the greatest ease. The volume is a large one, thus allowing the plates to be on a considerable scale. The descriptive letter-press is very clear. With the aid of this book even the amateur carpenter can do the work satisfactorily. The descriptions are given in the language of the trade, and are not so technical as not to be understood by the novice.

THE PHONOGRAPH AND HOW TO USE IT. Being a Short History of its Invention and Development, Containing also Directions, Useful Hints and Plain Talks as to its Care and Use, etc. New York: National Phonograph Company. 1900. 12mo. Pp 181. Price $1.

The subject has deserved more substantial additions to its literature than it has ever received. The present volume details the history of the phonograph, giving minute directions for its use and preservation, the manufacture of records of all kinds, and a considerable amount of additional information which will prove valuable to those interested in the phonograph.

A BRIEF HISTORY OF MATHEMATICS. Translations of Dr. Karl Finks Geschichte der Elementar-Mathematik. By Prof. W. W. Beman and Prof. D. E. Smith. Chicago: Open Court Publishing Company. 1900. 16mo. Pp. 330. Price $1.50.

The translators consider no apology is necessary for any reasonable effort to encourage the study of the history of mathematics, and they have performed admirably a most difficult task, which could only be done by mathematicians of the standing of Messrs. Beman and Smith, whose other writings on mathematics are so well known. The biographical notes contain brief biographies of famous mathematicians. It is a most interesting feature of the book.

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(7901) O. Y. asks: What is the difference, if any, in the use of fuel with a 200 horse power steam engine, requiring to produce only one-half its capacity. A. Much depends upon the kind of engine, whether condensing or not and upon the type of engine. There are constants of loss that continue the same with steam engines at full and half power. Radiation and condensation from the surfaces of boiler setting and in steam pipes remain nearly the same under both conditions. The friction of the engine is also nearly the same under varying loads. The steam generating power of the boiler, being larger in proportion to the amount of steam used at half power of the engine should save part of the heat going up the chimney and therefore should save fuel. The amount of steam saved will not be one-half, but a proportion covering the losses by radiation, condensation and engine friction. For a power-plant as stated we estimate that one-third of the fuel should be saved when running at half power.

(7902) S. Bros. write: We wish to make power to drive a small printing press (about one horse power). We thought of winding up a weight. Have you anything on this subject showing how to make it, or any other method of getting power that is simple and inexpensive? A. Spring power was quite a fad among inventors some years since and various methods and applications for storing power by springs, have been published in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 46, 47, 48, 50 and 473, which we mail at 10 cents each. A few spring motors are now made for fans and show window turn tables, and have been made for running sewing machines. They do not give out the amount of power required to wind them up, and when as much as one horse power or more is required we consider this method of accumulating power impractical and inefficient, whether by spring or weight. We advise the use of a gas or gasoline motor for driving a printing press or for any other use where a small and reliable power is needed. They are made of one, one and a half and up to any required power, are easy to manage and the cheapest small power known. See advertisements of these motors in our advertising columns.

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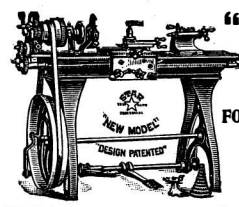

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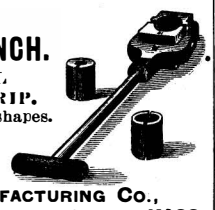

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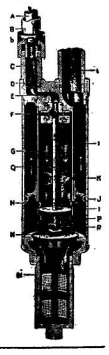

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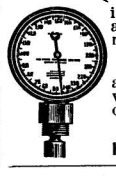

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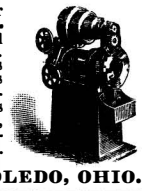

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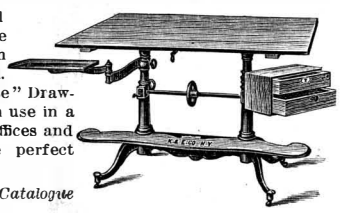

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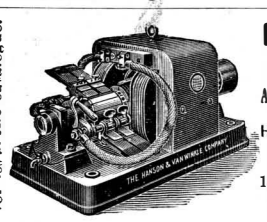

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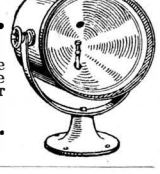

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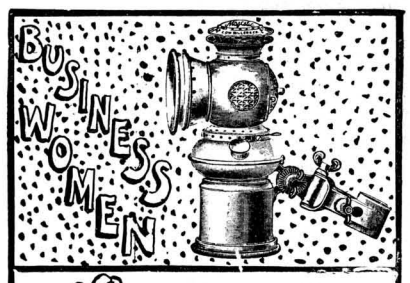

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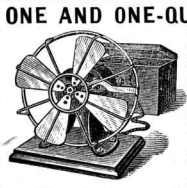

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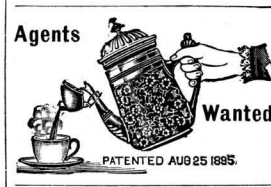

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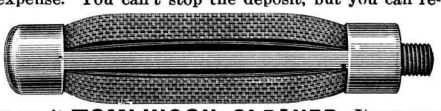

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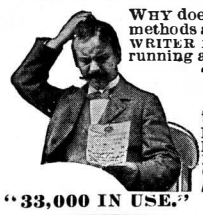

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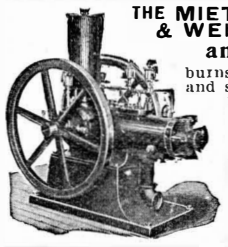

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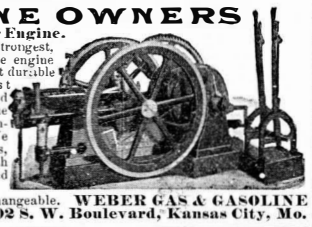

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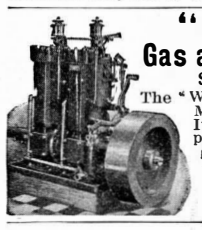

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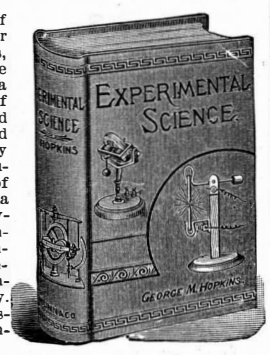

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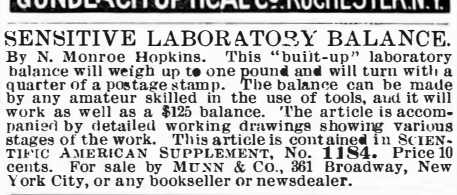
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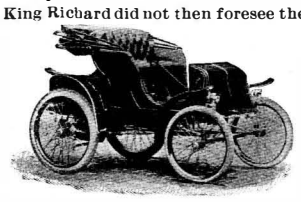

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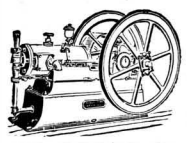

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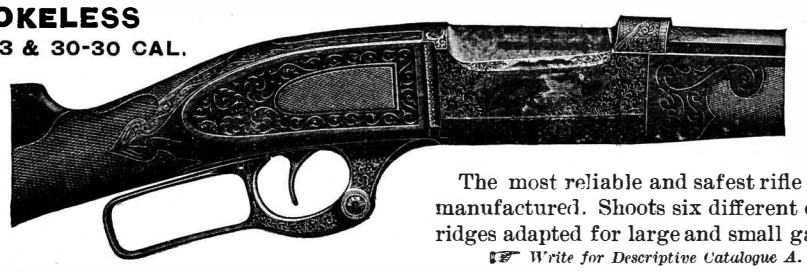

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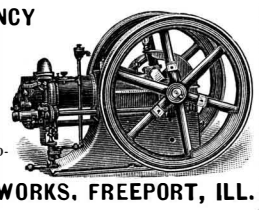

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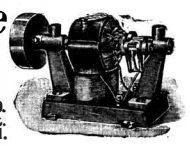

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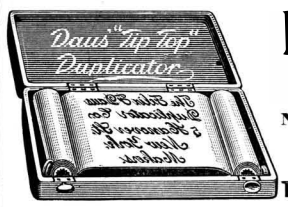

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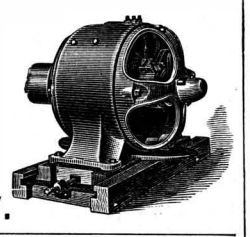

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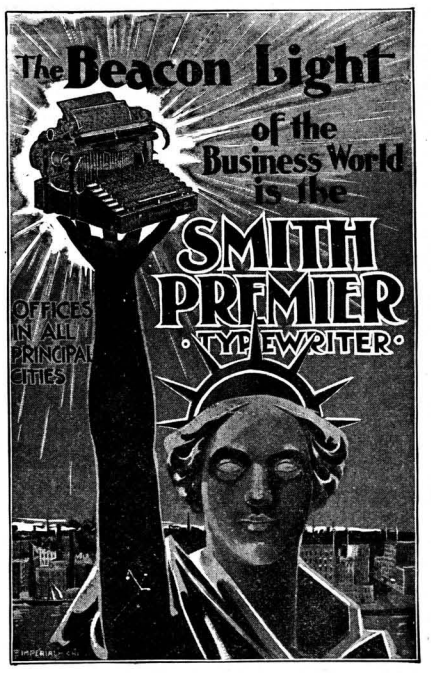

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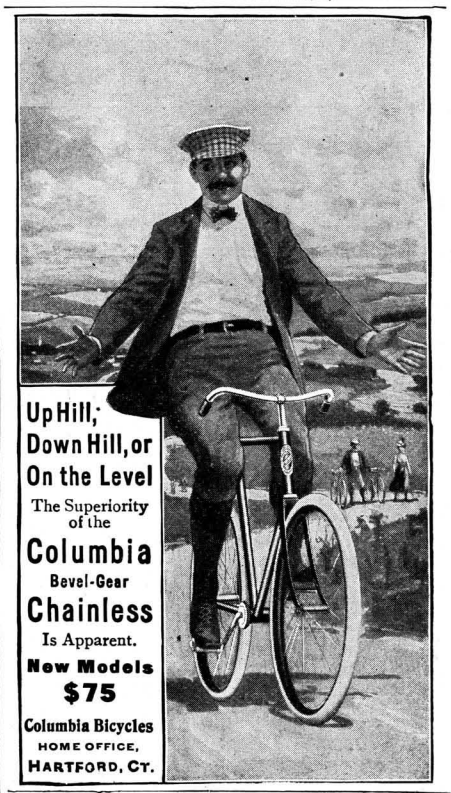

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